TELEPHONE ENGINEER

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THE NEW PUBLIC OWNERSHIP

The rapid increase in the number of stockholders in public utility enterprises seemingly is only a part of a greater movement if the observations of some of our economists are to be relied upon. Prof. T. N. Carver, head of the economics department of Harvard University, is reported in the daily press recently to have said: "The only economic revolution anywhere in the world that amounts to a hill of beans is taking place in this country now." Commenting on this, an editorial writer in the "Chicago Evening Post" calls attention to the fact that the revolution has been going on so quietly that comparatively few people have any conception of its character or extent.

Figures are quoted to show that the estimated number of stockholders in American corporations has risen from 4,400,000 in 1900 to 14,400,000 in 1923, while the average number of shares held per stockholder has decreased from 140.1 to 49.7. In 1921, the group of stockholders with annual incomes less than $20,000 a year received 53.2 per cent of the dividends, against 20.7 per cent five years earlier. In other words, the lower income class held the majority of the stock in 1921. These and other facts point to a remarkable emergence of the wage-earning class as purchasers of securities.

The distribution of corporation stock among employees and the efforts of public utility companies to place stock among their customers have contributed to this movement, which has taken place without a decrease in savings bank deposits or in the business of the insurance companies. Just what will be the outcome of this movement is a matter of speculation among economists and sociologists. There seems to be general agreement that it is working out toward a democratization of wealth and that it makes for social stability and general good.

A TRAVELING CHIEF OPERATOR IN EVERY STATE

That every state association should have a Traveling Chief Operator was the assertion made by President F. B. MacKinnon of the United States Independent Telephone Association at the Wisconsin state convention. There seems to be no question about this; we do not believe that any live Independent telephone man would argue that the statement is not true. Yet, when a census is made, it is found that only two or three state associations do have traveling chief operators. There are many associations that could have them but do not. President MacKinnon gave the reason for this condition later in the same address. Boiled down, it is because Independent telephone companies have been "laying down on the job" and have not been giving adequate financial support to the state associations. There is no question about this matter, either. The remedy is evident. The companies must get behind the state associations and organize them on a financial plan that will permit the association to do the work it should be doing.

A SUMMER GAME FOR TELEPHONE MEN

In the ancient and fascinating game of golf, if our information be not at fault, the player may go his round and keep his score for comparison with a certain number of strokes that is set up as a standard for the course. This is a mark to shoot at, and zest is given to the game because of the attempt to reach a predetermined standard of performance. The enjoyment of any sport comes from some competitive element; whether it be against the strength and skill of an opponent or against an arbitrary standard which the contestant is trying to meet.

Much of the same interest may be attached to everyday work, if the element of competition is introduced. There is just as much fun in doing a construction estimate at a cost inside the estimated figure, as there is in equalling a record in some other way. This, we are afraid, is a kind of enjoyment that many men, associated with the smaller companies, have missed. They have never gone through the process of figuring an estimate of the cost of the job and then keeping costs to determine if the estimate is met.

To the manager of the medium-size company and to his line foremen, both of whom are too busy to take vacations during the good

summer weather and who can not even knock off work in the afternoons for a half day on the golf links, we recommend the game of beating construction estimates. It is a good outdoor job, it has the competitive element and it is altogether a very enjoyable game.

NO ASSOCIATION BENEFITS FOR NON-MEMBERS

An Illinois newspaper tells of a telephone company which was among the sufferers from last December's sleet storm. Unable to restore service without an increase in revenue, it applied to the Illinois Commission for an increase in rates, only to find that the date for its hearing must be postponed until May 30th. This company was not a member of the Illinois Telephone Association and so could not take advantage of the general order permitting members of the association to issue bonds and notes and to increase their rentals to amortize such obligations.

A re-reading of the commission order does not disclose any explicit statement that companies not members of the telephone association are excluded from its benefits, but the title and text of the order clearly indicate that it applies only to member companies. Since non-member companies are not included, it is obvious that each should make an individual showing in order to obtain relief. If the newspaper we refer to is correct, the Commission has so interpreted its order.

Such an interpretation may appear to work a hardship on some companies which are not association members, while their neighboring association companies obtain relief through the open channel of the commission order. Looked at in its true light, however, no injustice is done. Membership in state associations is not compulsory and non-member companies have remained outside, voluntarily. Member companies have joined and have contributed to the maintenance of the association; accordingly, are entitled to its benefits. Non-members have no such claim. To save a small item of expense, they elected to remain outside. If they now suffer loss and inconvenience, it is because of this error in judgment, for which they and their subscribers now suffer.

WHY NOT UNIT-COST DATA?

It is surprising that telephone companies derive so little advantage from the fact that they are compelled by law to keep their accounts according to a uniform system. In many trade associations, the central organization collects and distributes accounting data for the benefit of all members. For instance, when a large department store, a member of the retail dry goods association, prepares its annual statement, the accountants prepare not only comparisons with previous years, but with the mean figures for the entire country. These mean figures enable the department store directors and manager not only to compare the performance of their business with previous years but with the average performance of others in the same line.

In the telephone business this is not possible, because average cost data are not available. It is true that some progress has been made by the United States Independent Telephone Association, but there is room for a great deal more work. The Association now prepares average figures on net earnings and ratio of net earnings to plant investment. Such figures are very useful, but they do not go far enough. A Class B company manager may learn that his company is earning only 5.1% on the fixed capital while the average is 5.5%, but this will not tell him the reason why he is below the average. To bring his company up to the average he may either increase revenue or reduce expense.

If a manager knows where his cost per station or his revenue per station deviate from the average, he is in a better position to take the necessary steps to correct the condition. For example, a manager, finding his cost for repairs to aerial plant running much above the average, could adopt a policy of gradual replacement of open wire by cable and, in a few years, could bring his property into line with the average of such companies.

The real reason why such average figures have not been available in the telephone industry is because there has been no expressed demand for them. Many managers have recognized their advantages, but have never made their wants known. To make such figures available, every company must furnish data, and some central agency must make the tabulations and comparisons. The effort required from any one factor would not be great; the results, except the average figures, could be kept absolutely confidential—and the benefits would be universally appreciated.

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Managerial Incentive Governs

Personal Ambition as Efficiency Incentive Is More of Factor in Correct Operation Than Rate Reward or Penalty—Outside Commissions' Scope

By ALBERT P. ALLEN

In his talk last fall before the U. S. Independent Telephone Association convention, as reported, C. O. Ruggles, Professor of Transportation and Public Utilities at the Ohio State University, called attention to a great many facts regarding the telephone business, and its relation to the public, which probably will be heartily agreed to by every telephone man and also by every intelligent citizen who has really given any special attention to the subjects covered. This applies to what he said regarding the necessity for keeping fundamental economic conditions constantly in mind; the absurdity of asking the general public to vote on utility rate matters or other purely technical matters which cannot be solved or even understood except by experts; the advantage of having public regulation of the utilities and the necessity of having the commissions made up of intelligent and broadminded men; and the fact that, whenever necessary, an increase in rates may be as much in the interest of the public as is a decrease in rates under different conditions.

His conclusion that the public is going against its own welfare in its recent opposition to state public utilities commissions, merely because they have found it necessary to allow rate increases, will also meet with the hearty approval of intelligent and well informed citizens, because they recognize that the matter of service is always more important than the matter of rates, and that unless rates fully cover all items of cost, neither a proper grade of service, nor the rapid extensions of service so necessary to our growing American cities can be secured. Also his conclusion that, in view of the far reaching and technical nature of the present day utility problems, "all talk about municipal home rule is bunk" will meet with hearty concurrence.

Business men at least will also fully agree with Prof. Ruggles that "regulation should not supplant management"; and it is fortunate that this fact is recognized not only by them, but also by the framers and interpreters of the laws dealing with the regulation of utilities.

Although agreeing with so many of the statements and opinions of Prof. Ruggles, it seems necessary, nevertheless, to differ with him when he discusses the question of efficiency or inefficiency in management, and especially when he argues that there is no escape from Government ownership and no hope for satisfactory regulation of private operation by public bodies, unless the latter can recognize efficiency and low costs of operation by "rewarding" such companies with higher rates than would be allowed to the same companies if the service rendered was not as satisfactory or their general efficiency seemed to be lower.

Albert P. Allen

The objections to his arguments and conclusions in connection with this matter are several in number and when analyzed appear to be conclusive. As this argument for rewards and penalties through rates seems to be the principal one which Prof. Ruggles aims to develop in connection with his talk; and since his conclusions, if correct, will make such a vital change in the future conduct and regulation of public utilities, they can not be allowed to pass without thorough analysis and open opposition from those who do not agree with him.

Management Outside Commission

The first objection to his plan is that any successful attempt on the part of a commission to determine justly and accurately the relative operating efficiency of two companies, and whether or not certain items of cost of either company are justified, is so nearly a matter of pure management that such matters have been omitted from the items for which commissions have been given responsibility under the law. Moreover, to cover them satisfactorily would require technical managerial ability and telephone experience, upon the part of the commission, which seldom if ever could be found in such a body. If such matters are to be put under the control of commissions, then Prof. Ruggles' further statement that "no sensible man would agree that regulation should supplant management" no longer holds, because such action certainly would at once tend to supplant and seriously interfere with private management.

Another objection to this solution of some of our troubles is the fact that all utility commissions are empowered, under the law creating them, with the same authority, and charged with the same responsibility to secure for the public satisfactory and adequate service, as is given to them to secure for the public satisfactory and reasonable rates. In other words, it is the duty of a utility commission not only to allow the utility to charge rates adequate to insure success in its financial operations, but also to secure for the public both good service and reasonable rates.. These two last items are not interchangeable and both must be secured, rather than one at the expense of the other, if a commission does its full duty towards the public. If, instead of accomplishing both purposes, the commission should admit its inability to force the utility to give good service and, on account of its failure in that direction, should then compromise the matter by forcing the utility to operate under reduced rates, the utility law would in no sense be prop-

*Commercial Engineer, Illinois Bell Telephone Company.

erly carried out and the commission would be subject to severe criticism; first, by the public who need good service, and secondly, by the utility management and the investors in the utility securities who need adequate rates to give such service. Such a solution of the problems involved cannot be the correct one. And the other side of the plan, which would force the public to pay extra for the good service it is entitled to under the law, is still less defensible.

As a matter of fact, however, the commissions seldom, if ever, have any trouble in forcing a modern American utility to give a reasonable quality of service, or of products, if such a result is practically possible at the time. There are, of course, times in the life of a utility during which it is practically impossible to give perfectly satisfactory service to every one who may apply for it at that time. But it certainly has not proven a serious problem with the commissions to have these temporary interferences with satisfactory and adequate service overcome and corrected by the utilities within a reasonable period. If this is true then it is not necessary to use inadequate rates as a club in order to secure good service. If such an instrument were used, the probability is that it would delay rather than hasten the establishment of really good and adequate service, because it would interfere so seriously with the raising of additional capital usually so particularly essential at such a time.

In this connection we can learn much from the experience of Chairman Gettle of the Wisconsin R. R. Commission, who said at the same convention:

"The Commission has endeavored to enforce the standards (of service) by persuasion and logic rather than by penalty, and I know of only one instance where it seemed necessary to impose a fine for non-compliance.

"The Wisconsin Telephone Company (Bell), although confined largely in its operations to the more populous urban centers of the state, has, through its highly trained experts, contributed liberally to the working out of conformity to our standards of service. There has been practically complete co-operation between the Independent companies, the Bell Company and the Commission in lifting the whole telephone situation to a high plane of excellence in operation."

Now let us examine closely the matter of efficiency of management to secure which Prof. Ruggles feels there is little that can be done, in connection with the modern utility, unless the Commission is allowed to aid in the securing of managerial efficiency through rewards and penalties in the form of higher or lower than normal rates. When the subject is carefully analyzed it is not too strong a statement to say that managerial efficiency (at least that of any company organized as a corporation, and having numerous stockholders and owners) never has had and never can have its operating and service efficiency secured merely through the medium of a higher return upon its investment. In other words, even if Prof. Ruggles' plan were tried, it would undoubtedly prove to be inoperative in so far as the main object of the plan is concerned. The reason for this is twofold.

Defects in the Plan.

In the first place, the proposed reward for managerial efficiency, being in the form of increased rates and increased return upon the investment, would go to the stockholders and not to the management. Now the stockholders of a utility, or of any other corporation, as such, have practically no way of directly affecting the efficiency of management. Theoretically and technically they control the board of directors, and the board of directors controls the president and officials of the company; but if there is a lack of efficiency in management at any time it is probable that no slower and more impracticable way of improving conditions could be found than an attempt to act directly through the stockholders. Moreover, if it once became known that the return upon an investment in utility companies could legally be based upon some other factor than the financial facts and requirements of the business, the result might easily prove to be adverse rather than favorable to the public interests. Such a plan can be thought of, therefore, as operative only in connection with a small, one-man, operator-and-owner company.

How then is efficient operation secured in a public utility? And is it true, to use Prof. Ruggles' words, that "if a telephone man knows that every increase in cost of operation is going to be met by an increase in rates," there will be "no incentive at all either to keep down the cost of efficient operation or be even much concerned over its increase"? The chief object of management, as a profession, is the securing of efficiency and low cost of operation without injuring the commercial and revenue producing side of the business. If these results are not obtained, the management is, to that extent, a failure. This fact is no more true of a private business than it is of a public utility having a monopoly of operation in the area it covers; and, therefore, it is not true that the real factors which result in operating efficiency are lacking when such a monopoly of utility operation and service is established.

The real reason why this well-known fact will bear close analysis is because the efficiency we are discussing is almost entirely a matter of the human element in the business, and of its psychology. From the day an employe becomes recognized as a leader through his ability to develop efficiency from a small working force, he has the ambition to secure the financial rewards of promotion, which are always greater the higher he rises in the organization. In this attempt to better himself he may care very little (and frequently knows very little) as to the exact financial standing of his company or the exact quality of service which is being developed and furnished to the average customer. Occasionally, of course, his work may keep him in direct touch with one or the other of these matters; but his ambition and determination to better himself is no greater in that case than it is if his line of work is such as to make such matters relatively unknown to him. But every such employe knows that his superior judges him entirely by results, and that his results are compared, with those doing similar work and having similar ambitions for advancement, by measures which are measures of efficiency.

The real incentive to efficiency therefore has always been, and so far as we can see always will be, the personal ambition of individuals to secure better positions; and this force is so constantly at work, especially within a large monopolistic utility, that the management has to be continually on guard to see that it is not carried to such an extreme, in any one department, as to react either on some other department, or on the service rendered, or on the relations of the utility with the public it serves. Those at the top of an organization have reached there as a result of long years of ambitious endeavor during which time this urge for efficiency in their own work, and especially as expressed in the work of those reporting to them, has been constant and effective. And since, in the case of a public utility, the strongest proof of managerial success is the ability not only to give good service, to create fine public relations, and to secure the capital necessary to conduct the business, but also to do all this and at the same time be able to reduce rates from time to time, the management always welcomes the opportunity for a possible voluntary reduction in rates as the strongest proof of efficient management. We can not agree, therefore, that there is no hope of securing efficient management if it continues to

be left without more direct control by commissions through the agency of rate rewards and rate penalties. It is even more difficult to see how greater efficiency and better service than is now secured without such control could be secured by the adoption of public ownership and operation, which Prof. Ruggles says is the only alternative to such a system of rewards and penalties.

Explained Increases Acceptable.

It has been the almost universal experience of telephone companies that there is very little direct opposition from their customers, and practically no falling off in patronage, due to any increase in rates, the necessity for which has been explained to them in any complete and satisfactory way. Some commissions, it is true, have been slow to recognize this fact, and a few still persist in the feeling, all too common amongst public officials, that the public will violently oppose any increase in utility rates just as they have been known to oppose increases in taxes. The commissions, however, have learned a great deal by recent experience; and if the utilities will thoroughly do their part in explaining the necessity for every rate increase put into effect, there will be very little objection to the new rates on the part of the public, and therefore very little opposition and antagonism expressed toward the Commission which authorizes the rates. When this happens there should be but little political capital to be made by refusing to grant necessary increases, and very little hesitation on the part of commissions to grant them.

A few days before the recent election one candidate for office was advertised by means of a human figure which paraded the streets of the Loop in Chicago during the noon hour with the candidate's name blazoned on its front and back. It was apparently walking on its hands, with its feet in the air and—perhaps prophetically—with its eyes turned downward and backward, thus preventing it from seeing what was ahead of it. The uniqueness of the attitude and the unusual position taken by the figure caused everybody who passed to stop and look at it; but it probably caused few, if any, of them to cast their votes in favor of that candidate.

Is it not possible that the peculiar attitude and sensational stand sometimes taken by public authorities in connection with some utility rate problems, in an attempt to win popular favor, will be found to be as ineffectual in winning and holding popular support as was that of the freak creature which paraded the Chicago streets before election? Certainly they will not prove successful if the public utilities keep on explaining the real facts of their business and the real relationship between those facts and the best interests of the public they serve; which best public interests, and not other selfish interests, the regulatory bodies are created to serve. Nor can they succeed if the actual ownership of the utilities continues to pass as rapidly as at this time it is passing into the hands of the public itself; thus giving the public not merely some selfish interest in a reasonable return but, more important still, a constant and reliable source of direct and reliable information as to the financial results and actual necessities of their utility companies.

Public regulation of privately operated companies is the right answer to the utility service and rate problem. It is improving in technique as its experience becomes greater, and it will never so far fail as to make government ownership appear to offer a hope of better results. Moreover it will prove particularly difficult to convince the average American citizen that the cure for inefficiency and poor service lies in turning over the business to a government bureau or department. He simply won't believe it.

Puxico (Mo.) Manager and Wife Stick to Finish in Fire

Puxico, Mo.—Devotion to public service again was in valorous evidence at a fire which recently destroyed a good part of the business section of Puxico. With the flames surrounding the building which housed the local telephone exchange, Mrs. Otto Sander, wife of

Mrs. Otto Sanders (in black coat) and Mr. Sanders, the tall youth in the right hand picture

the company manager, stayed at the switchboard trying to call for outside help, until overcome by smoke. Mr. Sander, arriving at the office when the building was in flames, and unable to reach the board, climbed the office pole and summoned help from Poplar Bluff, 25 miles distant. Upon missing his wife, Sander entered the burning building and carried his unconscious wife to safety.

Without resting from his thrilling experience, Sander at once tackled the job of restoration and put pay stations and toll lines into service in a few hours.

Many a Slip Twixt Snip and Skip in Tripoli

If you are contemplating a trip to Tripoli, take care not to be seized with a desire to cut any telephone wires while there, or you will never return to the United States. Bruno Roselli, professor of Italian at Vassar College, recently returned from Tripoli with the information that cutting telephone wires there is now punishable by death. Since Tripoli has been under the Italian flag capital punishment for all other crimes has been abolished.

Denver, Colo.—A $27,000,000 improvement campaign, covering the next five years, has been announced by the Mountain States T. and T. Company.

Abilene, Kan.—During 1924 United Telephone Company's 52 exchanges in north-central Kansas handled 62,000,000 local, and 1,600,000 toll calls.

Okonite Company Opens Chicago Office

Chicago, Ill.—The Okonite Company opened an office at 310 South Michigan avenue, Chicago, on February 1st and will take over the sale of Okonite products in the western territory. Charles E. Brown, formerly vice-president of the Central Electric Company, has been appointed vice-president in charge of the territory west of Pittsburgh and east of the Rocky Mountains of the Okonite Company with headquarters in Chicago.

L. R. Mann, formerly sales representative of the Central Electric Company, with headquarters at St. Louis, has been appointed manager of the St. Louis office.

Harry Miles, Coast Manager, Loses Daughter in Accident

Prosser, Wash.—Miss Marie Miles, daughter of Harry Miles, general manager of the Benton Independent Telephone Company, was killed recently, together with two of her schoolmates, in an automobile railroad crossing accident. Miss Miles was an accomplished musician, and was to have graduated from the Prosser high school this June.

Thedford, Neb.—H. L. Pollard, who recently bought the Loup Valley Telephone Company, plans to improve the plant.

Telephone Plant of Future

Automatic Networks for Agricultural Districts, With Automatic Two-Number Toll Service Is Forecast in This Article as Probable Development of Next Quarter of Century

By F. J. DOMMERQUE
Fellow, A. I. E. E.

Reviewing at the threshold of the year 1925 the changes wrought in the telephone plant since the beginning of this century one may well ask the question: "What will the telephone plant look like after another 25 years?" To answer this question positively, would be flying in the face of providence, but one may form a pretty fair idea from the trend things are taking, without running the risk of being pronounced a dreamer. The basis to work upon is solidly established, one needs only to join together the lines of development being drawn in various directions in various countries and draw conclusions therefrom to arrive at the probable ultimate outcome.

Any telephone plant, no matter how small, consists of three parts: Exchange, wire plant and subscriber's station. The latter seems to be the most stable part of the three. It may be said with a high degree of certainty that, if any part of the telephone plant survives the next 25 years in its present make-up or nearly so, it will be the subscriber's station. The common battery telephone and the dial are reduced to the smallest number of elements essential to the transmission of speech and the governing of switches, respectively, each element being as nearly perfect and simple as it can be made. Therefore this part of the telephone plant may be left out of consideration, the universal telephone of the future will to all appearances be the common battery telephone instrument of today with the dial in one form or another. Not so with the exchange and the wire plant.

Taking the exchange first, it may be defined as the office or offices where the lines are switched together for conversation. At the present time the majority of telephone plants have one single office, the limit of the single office plant being 10,000 lines. Plants of more than 10,000 lines contain more than one office. The majority of the plants are operated manually, only a small percentage of the plants in operation are automatic plants but manual exchanges are being transformed more and more into automatic exchanges whenever rebuilding is in order.

Taking this trend as an indication that the question of operation is settled in favor of automatic, a development study will show, whether the old office—and conduit system—are to be retained in full or in part, and what changes and additions will have to be made. In manual offices a continuous multiple is a necessity, which requires a multiple switchboard of considerable length, the housing of which requires a large floor-space area. The ceiling of the operating room must be high so that the operating room will be able to contain the air required for breathing by the large assembly of operators. The automatic switching paraphernalia constituting an office do not need to be arranged in a continuous line; they may be separated by switch classes and placed on different floors, or for instance, line switches and connectors on one floor, and group switches on another floor; nor do they require a high ceiling. Therefore when in an existing office building room can not be found laterally for expansion new stories may be added to house the automatic equipment. The quantity of automatic apparatus to be installed depends on the traffic and the size of the plant; and also on the system to be used.

Of all the automatic systems the Strowger system is the oldest, the best known and taking the whole world into consideration, the most widely used at the present date. For this reason there are more data at hand to draw from and to form an opinion of what will take place in the future. By Strowger system we do not mean any particular make, but a system composed of step-by-step motion switches in general, the switch classes being line switches, group switches and connector switches. For sake of simplicity we define line switches for our discussion as rotary or one-motion switches with direct selection, that is every subscriber's line terminates in the brush of such a switch, which selects a free trunkline out of 10 to a connector —or group switch—we define group switches as two-motion switches (lifting and rotating), a trunkline from a line switch or another group switch terminating in its brush which selects a free trunkline out of 10 to another group switch or to a connector switch; and a connector switch as a two-motion switch (lighting and rotating), a trunkline from a line switch or from a group switch terminating upon its brush, which test, for, and connects to the desired subscriber's line.

Development Study Determines Number and Location of Office.

To begin with a plant for a large city, the development study determines the ultimate number of offices. It also determines their theoretical location and boundaries. A special study will show which of the present offices can be retained. The development study characterizes also the offices as either main offices, branch offices or suboffices. There is not much difference between main and branch offices. Main offices as a rule are in that part of the city which is busiest, which is located in the center. Branch offices are of the same description as main offices only that they are located in the less populated districts. In automatic plants we have also suboffices, that is, offices which are too small to warrant independent operation. They are usually located at the outskirts of a city and constitute an important factor in any automatic plant because in the first place suboffices do not need any personnel. The wirechief in the nearest branch office can supervise a suboffice by a proper system of signals and meters; he can tell at a glance the behavior of the suboffice switches by signals on his desk or in his office; he can watch the condition of the suboffice storage battery by a voltmeter on his desk; troubles on suboffice subscribers' lines are reported at his desk and taken care of by his troublemen. In the second place all suboffice calls pass over trunks from the suboffice to the nearest branch office and if a call from a suboffice subscriber is for a subscriber beyond the branch office to which the suboffice is connected, it will pass over an idle trunk in the various trunk groups emanating from this branch office, thus adding to the economy of the trunk groups.

Local calls in the suboffice are trunked to the branch office and back again in case the local traffic is light; where local traffic is comparatively heavy, companion work switches are installed at the suboffice, to switch calls for a local subscriber from the trunkline going out to the branch office onto a connector in the suboffice provided especially for such

local calls. In a large city a main office probably will not have any suboffices. Suboffices will practically without exception be connected to branch offices.

Trunks Are Operated in Tandem in Automatic Network.

In a manual multi-office plant all offices are connected by direct trunklines, which is a necessity because it would require more than two operators to handle a call, if it had to pass through two or more offices in tandem, which would be inacceptable for operative reasons. In automatically operated plants a call can be switched through a number of offices in tandems, thus the great benefit afforded by large trunk groups can be realized to its fullest extent. Larger trunk groups mean less trunk mileage. The difference can be easily conceived by comparing the two sides of Fig. 1. On the left side the trunk connections between the 15 offices of an assumed manual layout are illustrated, on the right side the trunk channels for the same 15 offices are shown but with an automatic operation.

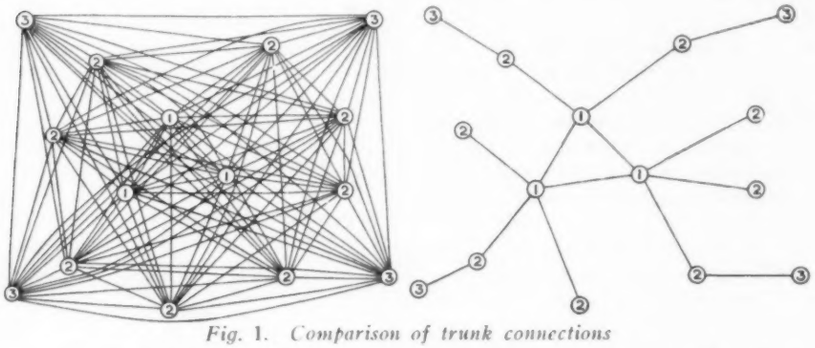


Fig. 1. Comparison of trunk connections

It would lead too far to go into trunk grouping here; this is a subject to be discussed by itself. Suffice it to say that proper grouping of trunk lines is a most important factor in the economy of the automatic telephone plant. In the 15 office layout the offices marked 1 are 10,000 line offices; the offices marked 2 are 5,000 line offices and the offices marked 3 are 1,000 line offices. In the automatic trunking scheme the offices 3 work into offices 2. The offices 3 being located at the outskirts of the plant have light traffic and their trunk business if passing direct to and from the other exchanges would not be sufficient to effect large trunk groups. Making offices 3 suboffices of offices 2 however will help the trunk groups.

Mr. Langer* calculated for the 15 office layout represented in Fig. 1 with assumed traffic and distances between offices the trunk mileage required for the direct connections in the manual case and for the tandem trunking in the case of automatic operation and arrived at 35,385 miles with 210 groups of trunks for manual operation and 29,280 miles with 30 groups of trunks for automatic operation. This is for a hypothetical case. In a real case there would probably be more offices of the No. 3 type, but smaller in size. However, Fig. 1 illustrates plainly the economical value of large trunk groups in automatic plants.

*Zeitschrift fuer Fernmeldetechnik, Oct. 31, 1923.

New York and Berlin Conditions Compared.

Looking at the largest city in this country, New York, which is at present transforming its plant into automatic operation, we have a 7 figure exchange (for convenience 3 letters and 4 figures are used). There are so many offices that they have been arranged in districts. Consequently we find line finders, district switches, office switches, incoming switches and final switches. All but the line finders are 500 line switches or frames as they are termed by their manufacturers, permitting the use of very large trunk groups, such as are easily obtainable in the largest city of the country. As it happens, New York is starting with the transformation of the largest offices first.

Berlin, not as large as New York, but still with over 4 million inhabitants, is also transforming its plant, but it transforms its small suburban offices first. In this plant Strowger type switches are employed. The reader will remember the short sketch of the Weilheim-Polling-Thuglfing exchange in the October 1923 number of TELEPHONE ENGINEER. This sketch shows what is being done at the present time in the Berlin suburbs, only the time-zone switches for charging toll calls are not put in operation, as the old method of toll charging cannot be changed until the entire system is ripe for it. The Berlin plant will be a million system, one district letter, one office digit and four figures will be used in the subscriber's number.

When New York and Berlin have completed their transformation all the offices in each city will be equally equipped and have the same method of operation. In New York the switches will be power-driven, in Berlin they will have a step-by-step motion. Of course the number of switches in each class will not be the same. The line finders in the New York offices and the line switches in the Berlin offices will depend on the number of subscribers and the number of switches in each of the other classes will depend on the traffic, but each system will be uniform in itself.

Automatic Networks in Rural Communities.

Suppose we had instead of a large city an agricultural territory with a number of county seats and many small communities. If we equipped these county seats as automatic offices and made the small communities suboffices of same, connected all offices by trunklines and let the suboffices call everywhere in the territory over these trunklines, we would have an equivalent plant to the city plant, only the offices would be smaller and the trunklines longer. The purely agricultural district would be the extreme in the opposite direction from the city of a size like New York or Chicago. There would also be industrial districts and mixed districts, but all would be provided with the same arrangement of switches and have the same trunking scheme. In short, we could divide the country into districts, all of which have the same uniform character of equipment and the same method of operation.

Toll Cable Development Important.

In a paper read before the A. T. E. E. October 1923, Mr. Harold Osborne said: "The telephone repeater has been developed to a point where a practically unlimited number of them can be used in tandem in a circuit without distortion of the telephone currents. This has, therefore removed the limitations which were set by high attenuation losses in cable conductor. Although there are other important limitations and there have been large difficulties to overcome, cable transmission can be made practicable up to a distance of at least 1,000 miles. As a result, the development of toll cables has become an exceedingly important phase of long distance telephone development and during the next few years it is expected that toll cables will be built in the Bell system at the rate of more than 500 miles a year.. . . An outstanding advantage of the cable type of construction is the ability thereby to concentrate a large number of circuits along a single route. . . The large number of circuits provided by one cable are obtained by the use of very small conductors, the gage in common use being 19 B. & S. and 16 B. & S. In the longest circuits two 19 gage circuits are required, each carrying the transmission in one direction only."

He calls attention to the fact that loading raises the efficiency of the toll cables; for this reason the toll cables are loaded. Repeaters are required at intervals of 50 to 100 miles. He supplements his paper by a map of the U. S. showing the principal repeater lines from ocean to ocean. In his conclusion he says: "By

means of the trunklines indicated in the map and a much more extensive network of shorter lines, it is possible to carry on satisfactory telephone conversations between any two cities of moderate size in the country and to a large extent even small places can communicate with each other, irrespective of their relative location."

At the end of 25 years the toll cable system of Mr. Osborne will be greatly enlarged. The cities, towns and communities along these cables will form automatic districts each covering a territory of say 50 miles in diameter for agricultural districts and of decreasing area with increasing concentration of population. The interoffice trunks will follow the cable routes and combine with them. The future wire plant will consist of 24 and 22-gage cable for subscriber's lines except perhaps for the longer lines in sparsly settled districts (the small gage wire is made possible by the decentralization in automatic exchanges and the consequent shortening of subscriber's lines in all but the just mentioned country sections); of 19-gage cable for interoffice trunks and toll lines; of 16-gage cable for the overland long distance lines, loaded where necessary. The uniform telephone plant, whether city or country district, will ultimately take on the universal character when the toll business is combined with it.

Zone System of Toll Charges Will Be Adopted.

At present, even in the existing automatic exchanges toll and long distance calls are handled by operators, the operation of the dial by the subscriber connecting to a recording operator. Some automatic features are creeping in, such as the use of automatic switches to connect the called party instead of plugging into a multiple. More of these auxiliary methods will be introduced from time to time, but the principal change, that is, the combination of the short haul toll business with the local business will not come until the charging method has been revised. Glancing once more at the little Weilheim plant described in October, 1923 we see the district divided into zones; the toll rates are arranged in multiples of the local charge and are automatically registered upon call registers by advancing it one, two, three or more steps according to the time need and the number of zones the call is to pass through.

Greater New York is also divided into zones and a toll charge of 5 or 10 cents is made according to the distance of the zone wherein the called party is located from the zone wherein the call originates It seems feasible to apply the time—zone charging method of Weilheim to New York when its automatic transformation is complete. This, however, does not mean that the exact process must be followed, only the idea is in the right direction.

With the method of charging in cities and district plants for all two-number calls (and all toll calls in a district should be two-number calls)—there would be only the long haul toll and long distance calls with their higher charges left for toll operators to handle; the charges would justify giving this class of business the special attention it demands.

There is some doubt in the minds of telephone engineers whether it would not be more economical to abandon multiplex telephoning and to provide individual channels in a cable for each conversation in place of all the costly paraphernalia necessary to accomplish the five or more transmissions over one circuit. If this should be done, it would advance further the calling of the long distance lines.

Summing up, the universal telephone plant of the future to all appearances will be automatically operated for local and short haul two-number toll business; will be an all cable plant; will cover a large city with its suburban territory or a telephonically equivalent district, which may be an industrial district with a number of good sized towns in close proximity to each other or a rural district with a number of county seats surrounded by small agricultural communities. The long haul toll and the long distance business will be carried on by operators on toll boards without subscriber's multiple over cable routes with repeaters. Party lines will either disappear or be greatly reduced, as decentralization and the small gage subscriber's line cable will render the subscriber's lines shorter and less costly. Probably the subscriber would be willing to pay a little more for a private line and the telephone company would be glad to free itself from the technical and administrative burdens imposed by party lines. A little concession on both sides would help matters materially.

Slingluff, Roebling Veteran Goes with American Cable

W. H. Slingluff, who represented the telephone wire department of John Roebling's Sons Co., at Chicago for over 26 years, recently became Western representative and district manager of the American Cable Co., of New York, with his offices in the Burnham Bldg., at 160 North La Salle street, Chicago.

Clearwater, Fla.—W. G. Brorein, president of the Peninsular Telephone Company, has contracted for the development of one of his Florida real estate holdings which is said to be among the most attractive waterfront properties in the state.

Two New Indiana Jobs Handled by J. K. Johnston

The Pike County Telephone Co., Petersburg, Ind., has made application for increase of rates and a $75,000 bond issue. The company, which operates exchanges at Petersburg, Winslow, Otwell, Monroe City and Wheatland in Pike and Knox counties is asking authority to purchase the Flint-Kyle Telephone Co. which operates exchanges in Montgomery and Epson in Daviess County, and to increase rates. J. K. Johnston, Telephone Engineer, Indianapolis, is making a detailed appraisal of the property of both companies and preparing the case to be filed with the Indiana Commission.

Star Telephone Co., French Lick, Ind., has filed a petition for increase of rates in French Lick and West Baden, Ind. The company will discontinue the exchange at West Baden, as a trunking cable is being installed, and subscribers will be connected direct with the French Lick exchange. Appraisal of property and preparation of this case also was made by Mr. Johnston.

Organize to Protect "Our Feathered Friends"

Chicago, Ill.—During one recent state telephone convention Ed and Bert Naugle and Tom Endsley started an organization to buy insulated booties for birds that delight to light upon the cross arms of steel poles. It has been the observation of the Naugle boys that our feathered friends stick one claw on a crossarm and the other, or a wing, on a transmission line as their last living act. Hence the protective measure of buying the insulated shoes. Hawks and other bad actors won't be cared for. Tom was delegated to catch the birds. In the event of the Illinois Electric man being unable to discharge his duty completely, the lines will have to use Naugle poles to replace the steel carriers. As may be readily imagined, this move started by the two Naugles is entirely without any ulterior motive. The sale of Naugle poles which may result is simply an extension of the Naugle service to man, bird, beast, fish and reptile.

Chas. T. Speice Buys Kingfisher (Okla.) Telephone Co.

Kingfisher, Okla.—M. M. Flickenger has sold his controlling interest in the Kingfisher Telephone Co. to Chas. T. Speice of that city. Mr. Speice took over active management of the company March 1, and the Flickingers have gone to Roswell New Mexico, where they will make their home. Mr. Flickinger had made Kingfisher his home for twenty-five years, and for the past eleven years had been manager of the institution sold.

Data on Exchange Cable

Methods of Making Cable; of Erecting Cable and Utilizing It to Greatest Advantage — Suggestions Regarding Specifications When Purchasing Cable—Its Strength, Insulation, Resistance, Lead Sheath, Vibration Strain, Etc.

By P. KERR HIGGINS

In previous articles we have discussed the pole line and have suggested suitable methods of guying as applied to aerial wire construction. The same general principles apply to exchange cable construction. In exchange construction only the best poles should be used and the selection of the stoutest of these poles should be made with a view to using them as cable terminal poles. The guying of necessity must be heavier, using in all cases special guy wire and messenger strand, as will be indicated later. The judgment of the man who lays out the plant may permit the use of patent anchors in exchange work, but the use of the "dead man" or anchor log is perhaps the safest for the average construction man.

Some of the advantages of cable construction are, first, greater assurance of uninterrupted service; second, a much better appearance on the streets; third, less liability to storm damage; and, fourth, where a large number of open wires are necessary the first cost and fixed charges are less as is also the maintenance cost than for open wire construction. Some of the disadvantages of cable construction are, first, higher electrostatic capacity; increasing transmission losses; second, higher resistance, reducing current of transmitters in common battery exchanges. Where an all cable plant is used, in a general way, the cable plant represents between fifty-five and sixty-five per cent of the total cost of the plant

Assuming that the ground work of the plant has been established along the lines indicated in the previous article, the careful foreman will make a comprehensive survey of the entire plant before actually beginning work. Many things must be taken into account such as obstructions, other companies' poles or wires, and the possibility of suitable anchor and guying privileges. In other words the engineer in laying out the plant assumes that the foreman in charge of the same has the intelligence necessary to meet changes when necessary by virtue of these obstructions. The old plan of using high poles is now a thing of the past and except at crossings a mean level of twenty-two feet, with twenty-five feet at the crossings, is considered good practice. It is well to determine this level before beginning actual work. As far as practicable, messenger wire should be graded to avoid abrupt changes of level. As a general rule, anchor guys should be very much stronger than the combined breaking strength of the messenger wire and should be so arranged on the pole that the messenger dead ends between two sets of anchor guys. Every anchor pole or stub should be protected by shims and have guy hooks to hold the anchor guys in position.

In pulling cable messenger, every step should be made with great caution. All ropes and slings should be carefully examined and this inspection should be intrusted to men who are known to be careful. Never allow a man unfamiliar with rope handling to tie a knot on which any strain is to be placed. The reasons for this are self-apparent. Messenger wire should be pulled with a pair of triple ten inch blocks arranged with a fall to pull from the center and with a pair of buff blocks on the main fall. While messenger is being pulled, the loose end should be passed around the pole and tightly clamped as a precaution of safety should anything give way. Wherever possible the handling of the blocks should be done from the ground. Under heavy strain there is a possible tendency of the blocks to twist and this must be watched carefully. This twisting may be prevented by a digging bar run through the hook or loop of the "hickey" and allowed to drag with its full weight. This has a tendency to keep the blocks from twisting. In using this method and while the messenger is taut, the end should be unclamped and passed twice around the pole and a pair of blocks used to take up the slack between the pole and where the "hickey" is attached. Avoid dead ends wherever possible to do so, as every dead end is a weak link in the chain.

Messenger wire should be strung in as long lengths as are possible. If practicable this should be from anchor to anchor. It is good practice to use booster blocks to assist in helping the slack along. These are usually placed between the two points that are being strung. There is much discussion regarding how tight messenger should be strung. The writer prefers pulling the messenger as tight as is possible and consistent with existing conditions. Loose messenger has been responsible for cracked and honey-combed sheath. The less vibration allowed on cables, the better the results obtained.

The object of flexibility studies is to enable us to quickly adapt the cable system to ever changing conditions of business at a minimum cost. The largest portion of investment in cables is usually in the main cables, hence it is well to allow a reasonable margin of growth beyond the actual demands of the business at the time of installation. Having determined the number of circuits necessary over a predetermined period for any particular cable, the size of the cable is determined by adopting the rule that the fill or per cent of working conductors in the main cable should not exceed eighty per cent. The same rule is practically true in determining the size of branch or tap cables, only in this case a sixty per cent fill is used. As a general rule it is cheaper to erect cable where more than two cross arms are necessary. This is especially true where there are obstructions such as trees, etc.

Engineers are still somewhat undecided as to the advisability of tapering cables, that is reducing the size as they work away from the office. However, this is the general practice at this time. The next step is to determine the most economical spacing of terminals along the route to be served. As a general rule no terminal of less than fifteen pairs should be used. In the present cable system, known as multiple cable distribution, the terminals in which the same pair or pairs shall appear are determined in advance so as to make the same pair or pairs available at several points. This system is especially serviceable where party lines are used.

It should always be remembered that a cable is only as strong as its weakest splice, as this seems to be the weakest point in the cable system. The type of cable generally used is one in which the conductors are insulated with a single or double wrapping of paper tape. The conductors thus insulated are formed into a cable and covered with a lead (or lead alloy) sheath. Such a cable is frequently referred to as a dry core lead covered

cable, and is used for both aerial and underground work. As indicated in a previous article pure lead is preferable for underground work and lead alloy for aerial cable.

The function of telephone cables is primarily to allow a considerable number of conductors to be installed in as small a space as possible, and it is now possible to make up cables in hundred pairs. The individual conductors after being insulated with paper are twisted together in twos to eliminate cross talk. They are then assembled together into a bunch or core, which is covered with paper tape. The tape core is then baked to remove any moisture, after which it is ready to be covered with a lead sheath. In order to facilitate the identification of the individual wires of a pair and to avoid crossing the pairs in splicing, they are covered with paper of different colors. In most cables, one wire is covered with red paper and the other with blue or white paper. As paper is very susceptible to the absorption of moisture, the ends of the cable should be hermetically sealed by solder until ready to be spliced.

Cable Manufacture Described

The raw materials used in the making of cable are delivered to the factory in car load lots. Copper in the form of ingots is handled through a wire drawing process until the proper diameter has been reached when it is wound into coils ready for the insulating process. The lead is received in "pig" and the insulating paper of special stock in rolls manufactured and treated expressly for this purpose. Each copper wire is separately insulated by a machine especially designed for that purpose. A roll of insulating paper of the required color is fastened to a head which is made to revolve. The copper wire of the required size is uncoiled from a stand on the floor. It is drawn up over a pulley through the center of the head and around a capstan. The revolving head winds the paper spirally around the wire. The insulated wire continuing on is then wound on a spool directly under the machine. The insulating wires are then twisted in pairs.

The twisted pairs are then sent through the stranding machines and formed into a core having the required number of pairs. The machine used for this purpose is divided into sections designated drums. To these drums are fastened the spools on which the twisted pairs are wound. As the drums revolve the pairs are unwound and from the spools and passing through a perforated disk attached to the drum and revolving with it are thus stranded into layers, each layer running diagonally across the one immediately within it. At each station is provided a button which enables the machine to be stopped instantly at any point when necessary. During this process the stranded core is covered with a spiral wrapping of two ribbons of insulated paper, each one overlapping the other. This paper wrapping is very strong, free from chemicals, etc., and capable of withstanding great heat. At this point the core is tested to see that the continuity of every wire in the cable is perfect and that the cable is free from short circuits, crosses, etc. It is then wound automatically onto an iron truck and thoroughly dried in ovens or drying rooms for a period of not less than twenty-four hours.

The cable is then passed through the process of encasing the core in its lead sheath. This is done by means of lead presses and hydraulic pumps. The lead being heated just enough to become plastic is forced under high pressure into a die block through the middle of which the core is drawn, in this way encasing the core in a seamless sheath of lead or lead alloy as may be pre-determined. A small portion of the sheath is forced through the die block before the first end of the core appears and this is bent and closed up in order to keep out the air. The end of the cable is sealed in a similar manner. As the sheath cable comes out of the presses it passes through a trough of mirrors to enable a careful inspection of the entire cable and to detect any possible flaws in the sheath. When the cable is cooled off it is then reeled and lagged and ready for shipment. Careful tests are made at the end of each process for resistance, capacity, insulation, etc. The writer had a wonderful experience recently in going through the factory of the Western Electric Company at Hawthorne, Ill., and in seeing the process of cable making, and is of the opinion that such a visit is well worth the time and money spent and would be invaluable with any one connected with the construction and maintenance of lead cable.

Electrostatic Capacity

Electrostatic capacity is one of the most important characteristics of a telephone cable. The effect of capacity becomes apparent when a sudden change is made in the strength of the current at the sending end. These changes are not reproduced instantly or of the same strength at the distant end. The time required for the change to travel along the cable depends upon the rate of change or frequency. The amount the current changes are weakened depends upon their frequency and the structure of the cable. Changes of high frequency weaken more rapidly than those of low frequency. The importance of this is evident when it is remembered that currents used in telephone work are of high frequency. The current wave is a very complex one and may be considered as made up of a number of waves having different rates of change. Those having a high frequency correspond to the shrill or high notes and those of a low frequency to the lower or deep toned notes. Those of a higher frequency travel faster than those of a low frequency and the result is that the high frequency waves gain on the low frequency waves. The combined current waves are thus altered or distorted, causing the tones produced at the distant end to appear muffled.

In order to obtain the lowest capacity possible wires are kept as far apart as practical. By using an insulating medium between the wires having low specific inductive capacity and wires of small diameter, the lowest capacity is obtained. Capacity varies inversely as the square of the distance between wires, directly in proportion to the surface of the wires and also directly as the specific inductive capacity of the insulating substance used. It is not practical to reduce the capacity of the cable beyond certain limits by increasing the distance between conductors, or by decreasing the size of the conductors, as this would increase the resistance. We are therefore compelled to use an insulating medium having the lowest possible specific inductive capacity. The inductive capacity of any substance (or dielectric) is the power it possesses of influencing a charge of electricity when used as a separator between two charged conductors. Dry air is the best known dialectric and has the lowest specific inductive capacity. Hence it is taken as the standard from which to compare other substances. The following table gives the specific inductive capacity of the principal insulating mediums:

Dry air	1
India rubber	2.220
Manila paper	1.500
Sulphur	2.58
Mica	5.00
Gutta percha	2.462
Paraffin	1.990
Shellac	2.76
Glass	8.00

Capacity Specifications of Cable

Capacity measurements are made by testing one conductor measured against all other conductors in the cable, grounded to the lead sheath (known as grounded capacity) or by testing one conductor against its mate, all other conductors in the cable being grounded to the sheath (known as mutual capacity). The latter is now the standard method of test. The arrangement of the wires for test is shown in Fig. 1. The relative values in micro-farads per mile are:

Grounded.	Mutual.
.08	.054
.10	.066
.12	.080
.14	.093
.16	.108
.18	.12

Mutual capacity is approximately 66 per cent of grounded. When wires are grouped together in a cable, their electrostatic capacity is increased.

"K. R." Law—Electrostatic Values

Several years ago one constantly heard the phrase mentioned above, but in recent years its use has been "conspicuous by its absence," at least among the men in the field. This law was used in obtaining the relative efficiency of telephone transmission through cables of having different conductor resistance and electrostatic capacity. The author of this law was an Englishman named Sir William Preece, and the law is expressed as follows: Capacity X by Resistance = a Constant. Evidently the law is based on the assumption of fact that as the resistance of a conductor increases, the talking efficiency decreases. In a similar manner if the capacity is increased, the speech transmission is impaired and when it decreases, naturally the reverse is true. The following table gives some electrostatic values per mile of cable at given resistances.

Size B. & S. G.	Ohms per mile of single conductor.	Values of K. R. for 10 miles of cable. Electrostatic capacity per mile. .08	.10	.12
19	46	368	460	552
20	58	464	580	696
22	92	736	920	1104

High and Low Capacity Cables

Cables carrying a higher capacity cost from ten to fifteen per cent less to make and frequently purchasers are ensnared by this lower price which is a grave mistake, especially on long talking circuits. The importance therefore of having low electrostatic capacity cannot be too strongly emphasized because the manufacturer is usually able to meet such specifications with a cable of smaller diameter and consequently a reduced weight of lead. It is well to remember that the electrostatic capacity is not only affected by the materials used, but also by the methods of manufacture. Present manufacturing methods permit makers to reduce the diameter of conductors while still maintaining the same electrostatic capacity or conversely get a lower electrostatic capacity for the same diameter.

The following table shows the various combinations of length, capacity and resistance of telephone cables necessary to produce the same talking efficiencies. It will be noted from the following table that a cable one mile long having No. 19 B. & S. G. wires and having a capacity of .08 mfs (micro-Farads) per mile will have the same talking efficiency as 3050 feet of No. 22 gauge wire and having a capacity of .12 mfs per mile.

Size B. & S. G.	Ohms per mile of single conductor.	Lengths of various cables for same talking values. Electrostatic capacity per mile. .08	.10	.12
19	46	5280ft.	4725ft.	4305ft.
20	58	4700ft.	4205ft.	3835ft.
22	92	3730ft.	3336ft.	3050ft.

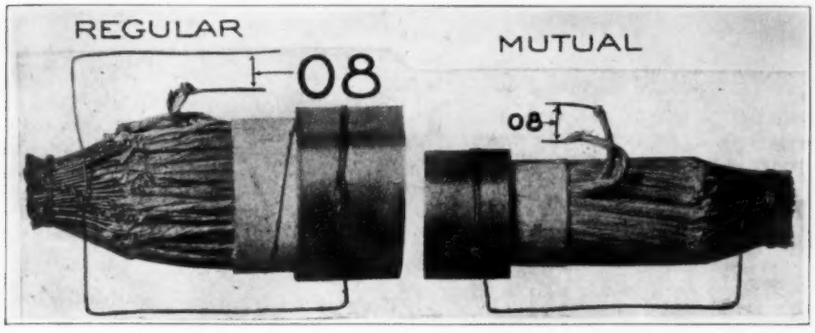


Fig. 1. Arrangement for capacity measurement

Some Notes in Specifications and Construction

In making up specifications for the purchase of cable it is well to avoid all reference to outside diameters, but emphasize the following points and see that they are adhered to:

Diameter of conductors.

Number of pairs necessary.

Number of paper tapes on each conductor.

Number of paper tapes over the core.

Average micro-farads per mile.

Maximum micro-farads per mile.

Whether mutual or to ground.

Sheath; thickness and composition.

The following table shows safe elastic limits for cables of different size and gauge:

No. of pairs.	Elastic limit of copper wires, in lbs. No. 19 Gage.	No. 22 Gage.	Increased elastic limit 10% for paper and lead in lbs. No. 19 Gage.	No. 22 Gage.	Increased elastic limit 25% for paper and lead in lbs. No. 19 Gage.	No. 22 Gage.
10	150	200	110	220	125	250
25	250	500	275	550	313	625
50	500	1,000	550	1,100	625	1,250
100	1,000	2,000	1,100	2,200	1,250	2,500
200	2,000	4,000	2,200	4,400	2,500	5,000
400	4,000	.....	4,400	.....	5,000	.....

The Elastic Limit of Various Size Cable.

The figures shown in this table, while approximate, are reasonably accurate.

It is well to remember that all that has been said previously pertains to the cable as manufactured and it is well to remember that the characteristics can be changed greatly by careless or indifferent construction work. We are therefore compelled to emphasize the importance of the following construction requirements:

1. Easy terms and not too long lengths between splices.

2. Careful handling both in transportation and actual work.

3. Importance of using reliable and experienced cable men.

4. Using only high-grade insulating materials.

5. The expulsion of every trace of moisture and air.

6. The elimination of salient or projecting points or angles of metal from the conductors and paper sleeves.

7. Hermetically sealing all joints and splices and ends of cable when exposed.

Practically all transmission losses in a cable are approximately proportional to the square root of the product of the mutual capacity and resistance. For standard cable a constant may be found by taking the square root of 88 x .054 which amounts to 2.18. The equivalent of any other cable may be determined by finding the value of the square root of the product of the mutual capacity and resistance and dividing this by 2.18. Then if the capacity of two cables are equal, the transmission is proportionate to the square root of the resistance. If we keep the capacity per mile the same, in order to double the talking efficiency of a cable, it will be necessary to quadruple the size of the conductor. The following table shows approximate values of transmission limits or the length of line of different cables and open wires, having a transmission loss equal to thirty miles of standard cable:

Cable	Miles
No. 22 B. & S. gage .083 mf. mutual capacity	18
No. 20 B. & S. gage .074 mf. mutual capacity	23
No. 19 B. & S. gage .074 mf. mutual capacity	27
No. 19 B. & S. gage .054 mf. mutual capacity	30
No. 16 B. & S. gage .074 mf. mutual capacity	39
No. 14 B. & S. gage .074 mf. mutual capacity	48
No. 13 B. & S. gage .074 mf. mutual capacity	55
No. 10 B. & S. gage .074 mf. mutual capacity	77
Open Wire	
No. 14 Birmingham wire gage, iron	75
No. 12 Birmingham wire gage, iron	94
No. 10 Birmingham wire gage, iron	120
No. 12 B. & S. gage, copper	246
No. 10 B. & S. gage, copper	353
No. 9 B. & S. gage copper	429
No. 8 B. & S. gage, copper	526
No. 6 B. & S. gage, copper	811
No. 8 Birmingham wire gage, copper	857
No. 12 New British Standard gage, loaded	909
No. 8 Birmingham wire gage, loaded	2,000
No. 8 Birmingham wire gage, loaded phantom	2,273

A phantom circuit built up on cable circuits is approximately ten per cent better than the physical, while a phantom circuit built up on open wire circuits is approximately twenty per cent better.

Concerning Strength of Cable

The copper and paper elements constitute the strength of the cable, as the lead is too soft a material and has too low an elastic limit to be of great importance. The function of the lead is to keep out moisture, but does not materially contribute to the element of strength. The elastic limit of copper is given at ten thousand pounds per square inch, while that of paper is still problematical. Considering the toughness of good paper, it may be assumed as having an equal factor. But as the paper thickness is so slight, it is apparent that it cannot add very greatly to the strength. The following table gives the thickness of paper and lead generally used for different sized cable:

No. of pairs.	Diameter of each wire.	Thickness of paper.	Thickness lead sheath.	Outside Dia. approximately.	No. individual wires.
No. 19 B. & S. Gage Cable					
10	.0359	.0004	1/12	9/16	20
25	.0359	.0004	1/12	15/16	50
50	.0359	.0004	3/32	1–3/16	100
100	.0359	.0004	1/8	1–5/8	200
200	.0359	.0004	1/8	2–3/16	400
No. 22 B. & S. Gage Cable					
10	.0253	.0004	1/12	17/32	20
25	.0253	.0004	1/12	23/32	50
50	.0253	.0004	1/12	15/16	100
100	.0253	.0004	3/32	1–7/32	200
200	.0253	.0004	1/8	1–25/32	400
400	.0253	.0004	1/8	2–3/8	800

Insulation and Conductor Resistance

Each wire should show an insulation resistance of not less than 500 megohms per mile when tested at factory and not less than 100 megohms per mile when laid, spliced and ready for use. In making this test each wire is measured against the rest of the wires in the cable with the sheath grounded.

Each conductor should have a resistance of not more than the proper amount specified and varying according to the diameter of the conductor. This conductor resistance should not change during or after construction work is completed.

What Constitutes Good Lead Sheath

The cable core should be enclosed in a pipe composed of commercially pure lead unless a percentage of alloy is specified. This pipe is to be formed around the core and have a specified thickness varying according to the size of the cable or as required by the engineer. The lead sheath should be free from holes and other defects and be of uniform thickness and composition. The following table gives suggested thickness of sheath in inches:

Thickness of Sheath in Inches

No. Pairs.	No. 22 B. & S. G.	No. 20 B. & S. G.	No. 19 B. & S. G.
25 and less...	5/64	3/32	7/64
50 and less...	3/32	7/64	1/8
100 and less...	7/64	1/8	1/8
Over 100.....	1/8	1/8	1/8

Specifications for Paper Wrappings

Specifications should require a given number of paper wrappings, the most commonly used by Independent companies calling for two wraps applied spirally in opposite directions. This is mechanically superior to any other method of applying the insulation such as a single spiral wrapping, or where the paper is applied in longitudinal strips held in place by a cord or thread. The paper wrapping should be of heavy manila rope paper over the core, overlapping upon itself at least one-fourth of its width, thus giving a superior mechanical construction. This insures the conductors against crosses or grounds due to the handling of the cable or a cross with lighting or power circuits. The insulation of each conductor should be capable of withstanding a potential of 500 volts without rupture. The requirements of some companies are that it shall stand a direct current potential of 500 volts between any wire and its mate or between any wire and all of the remaining wires and the sheath of the cable. This is very important on account of the possible failure of protectors to operate properly against lightning charges or when wires come in contact with power circuits. It is, therefore, very important that open space cutouts used for protecting cables will operate at potentials lower than the breakdown potential of the cable. As it is not considered practical to maintain open space cutouts much below 500 volts, this figure marks the minimum dielectric strength which admits of suitable protectors being used. The following tables show the effect of drying paper cable and cable insulating paper:

Effect of Drying Paper Cable

300 Pair No. 19 B. & S. Gage

Insulation megohms per mile.		Mutual capacity mf. per mile.		Damping constant S/2C (1,000 p.p.s.).	
Green core.	Finished cable.	Green core.	Finished cable.	Green core.	Finished cable.
300	1550	0.082	0.071	19	12

Effect of Drying Cable Insulating Paper

Condition of paper.	Thickness of paper.	Capacity of condenser micro-microfarads. Discharge.	1,000 p.p.s.	2,000 p.p.s.
Undried	0.0085 in.	11,000	7,020	6,953
Dried	0.0085 in.	5,792	5,780	5,779

Vibration Strain on Cable Sheath

The effect of vibration on cable sheath is also a very important requirement in cable work and the following table gives some results along this line which may prove useful:

Vibration Strain for Cable Sheath Materials

	Material	Weight suspended	Time of stress
1.	Lead pure	13 lb. 2 oz.	55 m.
2.	Lead pure	6 lb.	10 hr. 15 min.
3.	Lead 99.5%, tin 0.5%	13 lb. 2 oz.	32 hr.
4.	Lead 99.0%, tin 1.0%	a—13 lb. 2 oz.	74 hr. with "a"
		b—23 lb. 2 oz.	and 1 hr. with "b"
5.	Lead 97.0%, tin 3.0%	a—13 lb. 2 oz.	48 hr. with "a"
		b—23 lb. 2 oz.	and 9 hr. with "b"

Unfortunately the figures for lead antimony are not at hand.

Expansion and Contraction in Aerial Cables

Where aerial lead covered cables have been attached to the messenger strand without providing for sufficient movement to enable them to take up their expansion and contraction relative to the strand, trouble has frequently occurred. This is generally due to crystalline fractures in the sheath which allows moisture to enter the cable. These defects usually have a lumpy appearance of the sheath and a tendency of the cable sheath as a whole to assume a wavy form, in some cases rising above the supporting strand. That considerable expansion occurs has been clearly proved by cable sheaths showing bright spots where they have moved through metal cable clips when the latter were rusted to the strand and in some cases hangers have been torn off. Therefore in order to prevent undue trouble caused by expansion and contraction, aerial cable should be carefully strung and properly maintained. Many engineers claim that a tight messenger gives better results than a loose messenger and this has been the experience of the writer. However, good judgment must be exercised as it is possible to pull the messenger too tight. Avoid pole dips in cables; also cable hangers which clamp tightly to the cable and are not flexible. Replace immediately all hangers which have become unhooked or broken. The co-efficient of expansion of lead is approximately twice as great as that of steel. Lead sheath will expand about two inches for 100 degrees Fahr. rise in temperature in 120 ft. span. The messenger will expand less than one inch for the same temperature rise, disregarding in both instances the tension on the line. The expansion of the copper wire in the cable being less than lead and greater than steel may be disregarded.

New Insulation Testing Instrument

Herman H. Sticht and Co. of New York have issued a bulletin describing a new instrument known as the "2 in 1 Megohmer." The instrument is designed for making measurements of insulation resistance, either with the use of a generator in the set or the line voltage. The voltmeter may also be used separately. Copies of the bulletin may be obtained upon application.

Pennsylvania Has Largest Railroad P. B. X.

Philadelphia, Pa.—The largest private branch telephone exchange operated by any railroad in the United States or in the world is located in Broad Street Station, Philadelphia, the headquarters and general offices of the Pennsylvania Railroad System. This exchange consists of a board containing 23 local positions and 6 long distance or toll positions. Of the local positions, 22 are equipped and operated.

The exchange is connected through 35 long distance circuits, belonging to and operated by the Railroad Company, with 150 different cities and towns on the Pennsylvania Railroad System. It is conencted with the Bell Telephone System through 100 trunk lines to the Spruce Exchange in Philadelphia.

This board has 1,500 local lines connected with stations in the company's offices. It handles over 1,000,000 long distance calls annually, and in 1924 produced a total service amounting to 7,142,116. It requires 40 operators to handle this traffic.

New York Gains 205,000 in Record Year

New York City—President James S. McCulloh, of the New York Telephone Company, in summarizing the record year of the company enjoyed in 1924, said: "After more than five years of continuous effort, we have succeeded in meeting practically all of the backed-up service demands which accumulated during the recent building booms and post-war period of business expansion, and we now are able in practically every part of our territory to care for new service requirements promptly.

"Even though the number of telephones in service has almost been doubled within the past six or seven years, the necessity for continued enlargement is great, for nowhere is there evidence that the saturation point has been reached.

"Last year 36 new central offices, of which 13 are of the machine switching type, were placed in operation, and additions were made to 189 other central offices. New telephones numbering 464,000 were connected with central offices and 259,000 telephones were disconnected, leaving net gain for the year 205,000. Additions of wire to the system totaled 1,695,000 miles. This includes open wire on poles and wire in aerial, underground and submarine cables. Twenty new building projects were begun during the year and 23 others were completed. Among those commenced is the 29-story central office and administration building.

Pennsylvania Railroad's Broad Street (Philadelphia) Station Exchange—World's Largest P. B. X.

Ohio Bell to Have New Toledo Home

Cleveland, O.—The Ohio Bell Telephone Co. announces that plans have been completed for a telephone office and operating building on Huron St., between Jefferson Ave. and Monroe St., Toledo, made necessary by the rapid growth of that city. This building will be of the most modern and attractive architecture, and will cost about $1,000,000. It is expected the actual construction will be under way within the next month.

The initial building will be seven stories high, with foundations designed for twelve stories, and will be of structural steel and reinforced concrete, with a stone facade and exterior trim. Two basements will be provided to house the heating plant, machinery and power apparatus for operating the telephone equipment.

The first floor will be utilized by the telephone company as business offices and also will contain several attractive storerooms. The second and third floors will be utilzed for the central office equipment, which will be of the machine switching type for local service, and will replace the present "Main" and "Adams" manual offices. The fourth and fifth floors are to be occupied by the operators' training schools and the division and district offices of the company. The sixth floor will contain the testing equipment and the frames and racks for the Long Distance switchboards, which will occupy a part of the seventh floor, together with the operators' rest rooms, locker rooms, dining room and kitchen equipment.

The first three floors will cover the entire lot, which has a frontage on the west side of Huron St. of 157 feet and a depth of 120 feet to the alley in the rear The fourth, fifth and sixth floors also will cover the entire lot, with the exception of a light court about 20x60.

Every Man His Own Income Tax Expert

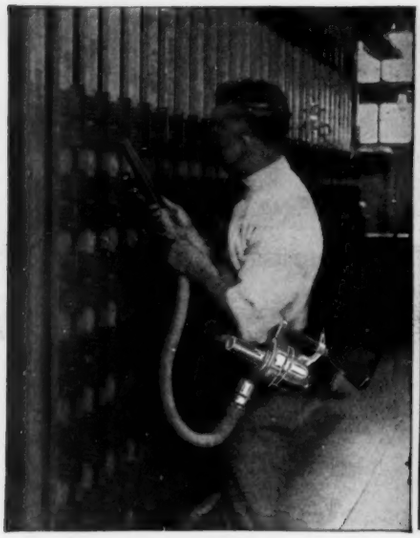
So necessary to every business man is Greenwood's Business and Income Tax Record that the publishers, the Greenwood Co., of 712 Federal St., Chicago, offer the privilege of 10 days examination without charge. There is no obligation to purchase and no strings attached to the offer. If the system does not meet your needs, all you have to do is send it back and you wont owe a cent. Just now a special wholesale price of $3.50 is in effect for this book; or a more elaborate, loose-leaf system book may be had for $7.50. The Loose Leaf Binding possesses all the advantages of the Permanently Bound Record with the added advantage of having three times as many pages and the opportunity to add more to it whenever needed.

A New "Copperweld" Index Shet Is Issued

The Copperweld Steel Co., Braddock, P. O., Rankin, Pa., has issued a new index sheet, revised to February, 1925, covering engineering data sheets on Copperweld products. A revised section on Copperweld ground rods also has been issued. These publications have been sent to all on the company's mailing list. Anyone not receiving the sheets may secure a binder and copies of sheets heretofore issued by addressing the company.

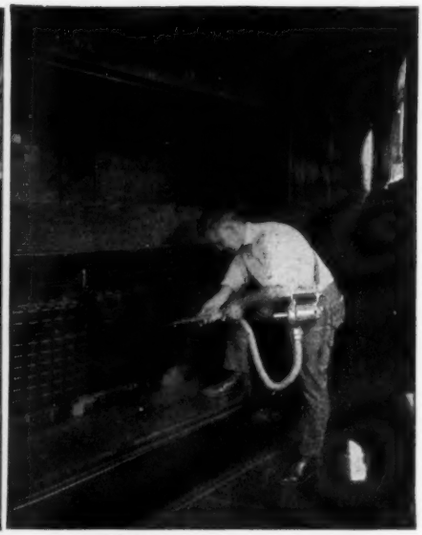
Geneseo, Ill.—F. Trautwein, secretary-treasurer and general manager of the Morrison (Ill.) Telephone Company, and J. A. Riordon, president of that company, have bought about a quarter of the stock of the Geneseo Telephone Company. All of the holdings of James B. Ensey, manager of the Geneseo company, have changed ownership in the deal.

Columbus, Ohio—A. G. Tresenrider was elected president of the Ohio Bell Telephone Plant Association at its annual meeting.



Main frame equipment readily cleaned with Little effort

Cleaning multiple cable in rear of switchboard with Premier vacuum cleaner



Premier handy cleaner easily takes dust from switchboard apparatus

A Special Vacuum Cleaner for Telephone Companies

The Premier Handy electric vacuum cleaner, for cleaning telephone equipment, weighs but 6½ pounds and has a handle resembling that of an electric iron. It is supported by a strap over the operator's shoulder. Equipment supervisors and maintenance supervisors of telephone plants in different sections of the country report most favorably on its operation and a great many of these machines now are saving time and expensive equipment in telephone exchanges where they are used for cleaning switchboards, cable runways, relay racks and distributing frames, and for general cleaning of telephone equipment and apparatus.

The Premier handy cleaner may be used both as a suction cleaner or as a blower. As a blower, it is necessary only to remove the bag, attach the blower coupling and put on the hose. A powerful blast of air is available at once for cleaning surfaces that are inaccessible to suction tools.

The Premier Handy is supported at the operator's side and is out of the way of equipment. The operator may stoop, climb a ladder and get into otherwise inaccessible places, because of its compact construction and unique method of usage.

The Premier Handy cleaner is guaranteed by one of the leading makers of vacuum cleaners and service and repair parts are furnished by 46 service stations in principal American and Canadian cities. Several telephone equipment houses handle it and report their customers as being uniformly well pleased.

Ward Soldering Iron Gets O. K. from Telephone Men

Chicago, Ill.—Within a comparatively short time the Ward electric soldering iron has made a name for itself in the telephone industry, and has been endorsed by a large volume of sales. The iron is made in straight and swivel point styles, the swivel point style being the one that has jumped into wide popularity because of its handiness around switchboards and in other details of telephone company work where soldering irons usually are awkward to handle.

The low price of the Ward iron is one of its big points, for the appliance is guaranteed for a year after purchase. The straight point sells for $2.75 and the swivel point for $3.25.

The heating element of the Ward iron is constructed of nickel chromium wire wound on a lava rock core and insulated with mica from the surrounding metals. The irons draw 100 watts of current, and are approved and listed as standard by the Underwriters Laboratories.

All soldering irons before being shipped from the factory are subjected to a 500 volt insulation break down test, in accordance with the Underwriters Laboratories requirements.

The iron can be used on 110 volt A C or D C, and also on 220 and 32 volt currents.

The swivel feature is Ward's patented idea. The swivel point iron comes with either a diamond shape or screw driver shape tip as requested. The straight point iron is furnished with two tips, one a blunt tip for heavier work.

Foreign Telephone Development, 1924-1925

European publications carry a number of items of interest, showing telephone development in foreign countries during the past year and plans for 1923.

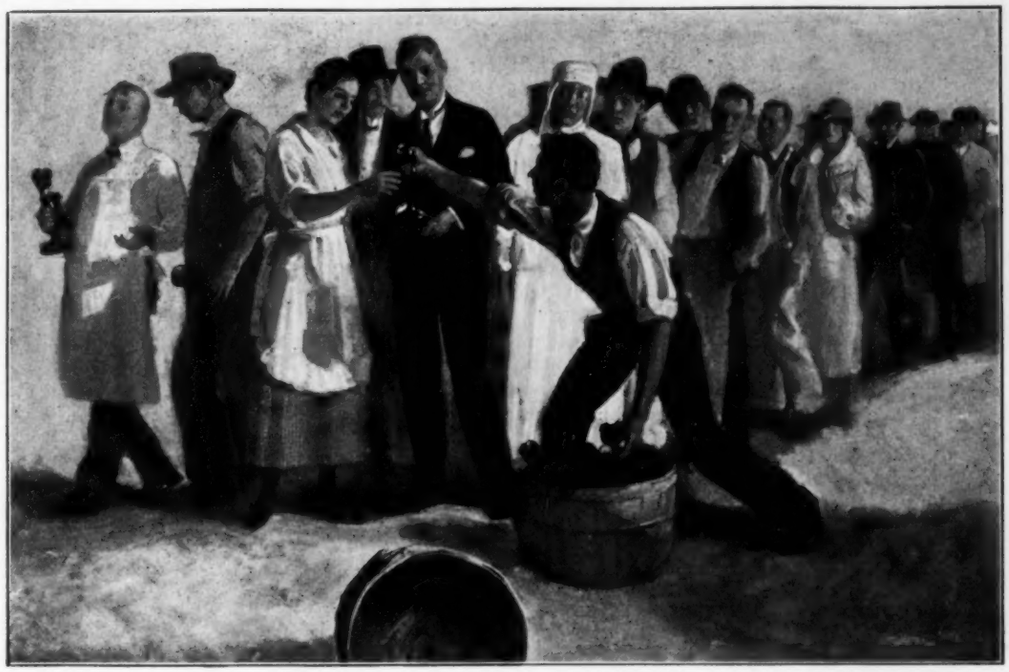
In Sweden, it is reported that the Telegraph Administration soon is to place orders for automatic operating equipment for over 30,000 subscribers to be installed in the cities of Stockholm and Gothenburg.

The "London Times" reports the establishment of telephone connections between Switzerland and Copenhagen, Denmark. In England, the toll service will be extended to Kentish coast towns and to other points. The first automatic exchange of the London network has been designated as "Sloan" and a new tandem office is being installed which will serve as a transfer station between the automatic and manual offices. The total number of offices in the ultimate plan is 71.

"Electrical Review" (London) reports that specifications covering the construction and exploitation of a telephone system in Syria and the Lebanon are now available. The concession will extend for a period of 50 years.

The completion of the automatic system in The Hague, Holland, is expected during the current year.

"Engineering" reports that the Post and Telegraph Department of South Africa will install first units of automatic systems at Port Elizabeth and Pietermaritzburg. The new long-distance wireless station near Cape Town is under construction and licensed broadcasting stations are in operation in various important centers.



Give us Telephones!

Following the war, when business and social life surged again into normal channels, there came the cry from homes, hospitals, schools, mills, offices—"Give us telephones." No one in the telephone company will ever forget those days.

Doctors, nurses and those who were sick had to be given telephones first. New buildings, delayed by war emergency, had to be constructed, switchboards built and installed, cables made and laid, lines run and telephones attached.

The telephone shortage is never far away. If for a few years the telephone company was unable to build ahead, if it neglected to push into the markets for capital and materials for the future's need, there would be a recurrence of the dearth of telephones. No one could dread that so much as the 350,000 telephone workers.

Bell System engineers measure and forecast the growth of communities; cables, conduits, switchboards and buildings are planned and developed years ahead, that facilities may be provided in advance of telephone want. Population or business requirement added to a community must find the telephone ready, waiting.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

One Policy, One System, Universal Service

Toxic Action of Creosote

A Study of the Relative Effectiveness in Preventing Decay of the Various Constitutents of Creosote — Conclusions Indicate That Lower Boiling Materials Are Most Toxic

By E. BATEMAN[2] and C. HENNINGSEN[1] *

A study of the relative effectiveness in preventing decay of the various constituents of creosote. Conclusions indicate that lower boiling materials are most toxic.

Research on the mechanism of the protection of wood by preservatives began with two working hypotheses; first, that any wood preservative must be capable of exerting a poisonous or toxic action on timber-destroying organisms and, second, that for the poisons to be effective they must be sufficiently soluble to exert a poisonous effect in the body fluids of the organism which they are intended to inhibit. In the case of timber-destroying fungi, at least, this means that the preservative must be soluble in water to the extent that the organism may be given a lethal dose.

It is believed that these hypotheses have been proved correct, for the following reasons:

(1) It has been shown in the case of phenols (tar acids), aromatic hydrocarbons, and tar bases, that the potential toxicity of the individual constituents in each class of compounds increases with increase of molecular weight. In general, this means that in the same class or series of compounds the higher-boiling ones are the more toxic. In the tar acid series, for instance, cresol is more toxic than phenol, xylenol is more toxic than cresol, beta-naphthol is more toxic than xylenol. Inversely, the lethal dose of any particular constituent, from which the toxicity is determined, is a gradually decreasing function of molecular weight.

The solubilities in water of organic substances, in general, decrease rather rapidly with increase of molecular weight in the same series. If the toxicities of the various members of a series are plotted as lethal concentrations against their molecular weights a curve will be obtained, and if the solubility data for the same series is plotted on the same paper a second curve will be obtained. The second or solubility curve on account of its steeper slope will cross the toxicity curve. Necessarily, all of the compounds to the left of this crossing point are sufficiently soluble to kill timber-destroying fungi; none of those to the

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*Paper presented before twenty-first annual meeting of the American Wood Preservers' Association, Chicago, Feb. 3-5, 1924.

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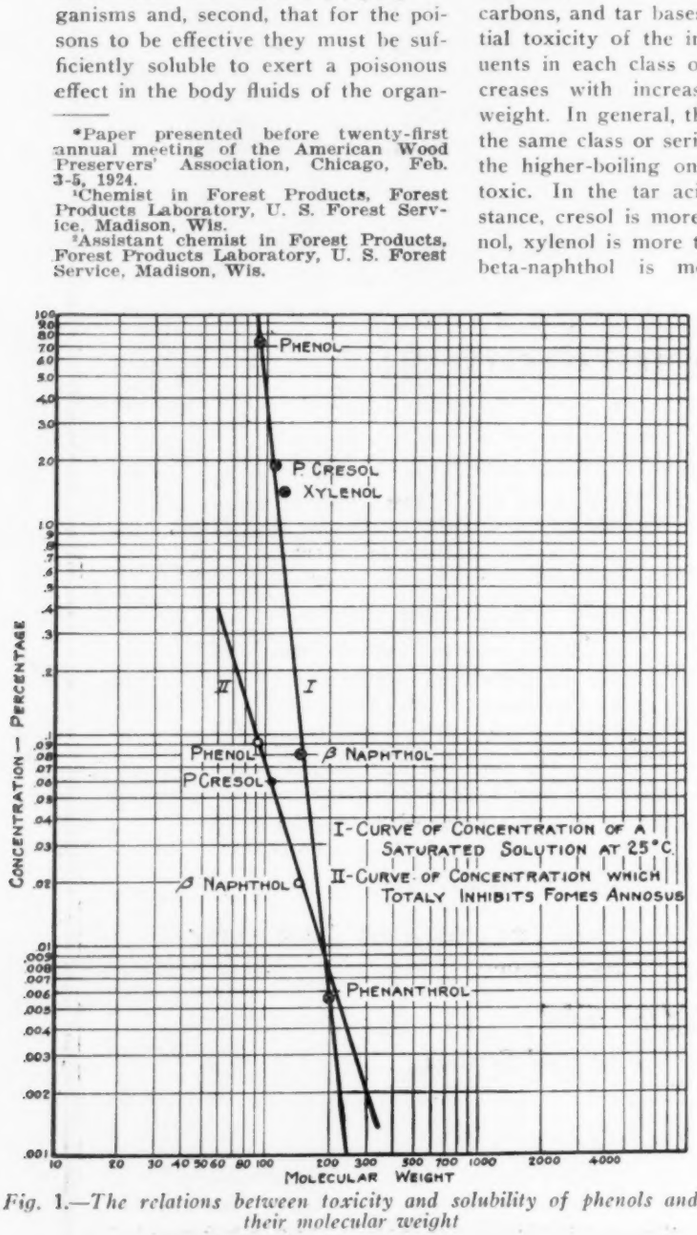


Fig. 1.—The relations between toxicity and solubility of phenols and their molecular weight

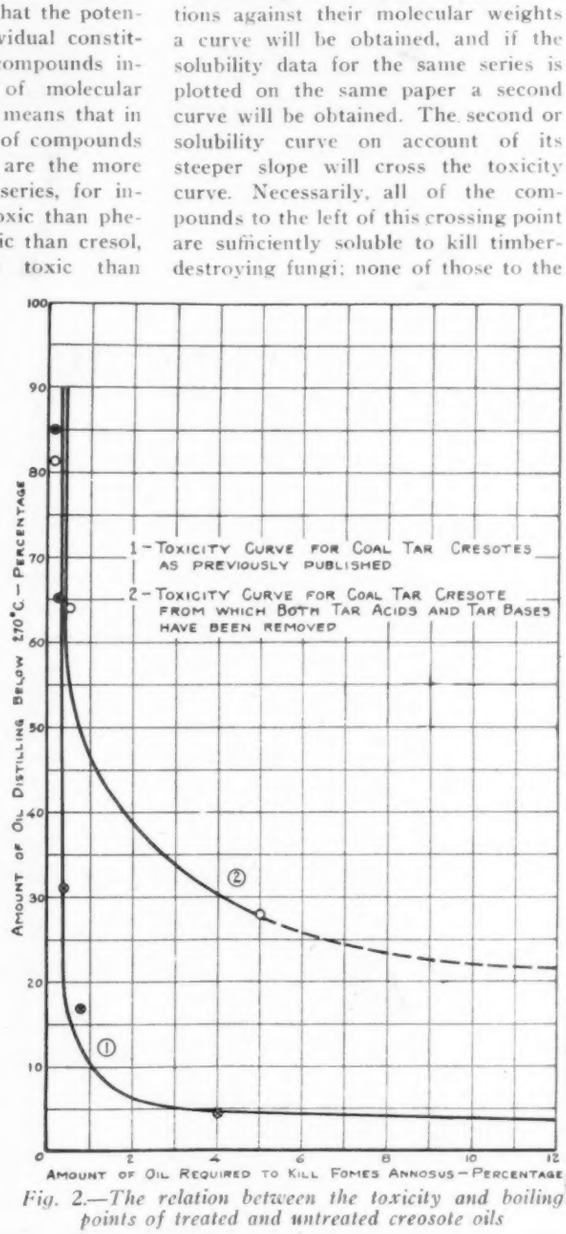

1-TOXICITY CURVE FOR COAL TAR CREOSOTES AS PREVIOUSLY PUBLISHED
2-TOXICITY CURVE FOR COAL TAR CREOSOTE FROM WHICH BOTH TAR ACIDS AND TAR BASES HAVE BEEN REMOVED
AMOUNT OF OIL DISTILLING BELOW 270°C. — PERCENTAGE
AMOUNT OF OIL REQUIRED TO KILL FOMES ANNOSUS — PERCENTAGE

Fig. 2.—The relation between the toxicity and boiling points of treated and untreated creosote oils

right are sufficiently soluble to kill, though they may and do exert a retarding influence on the growth of such organisms. These relations are illustrated in Table 1 by two series of compounds, the phenols and aromatic hydrocarbons. Curves plotted from the same data are shown in Fig. 1. It is possible to calculate the amount of retardation which would be obtained from a saturated solution of a material not soluble enough to kill if we have the ratio of change in concentration of the solution to its change in toxic effect. These calculations would not hold good unless the solubility of the material were a limiting factor in its toxic effect on fungi.

TABLE 1—COMPARISON OF MOLECULAR WEIGHT WITH TOXIC EFFECT AND SOLUBILITY OF HYDROCARBONS AND PHENOLS.

Material	Molecular weight	Solubility in water at 20° C. Per cent	Toxicity concentration lethal to Fomes annosus Per cent
Phenols:			
Phenol	94	7.5	0.1
Cresol	108	2.2	0.06
Xylenol	122	1.4	0.04
Beta naphthol.	144	0.08	0.02
Phenanthrol ..	198	0.005	*
Hydrocarbons:			
Benzene	78	0.19	0.016
Toluene	92	0.057	.....
Paphthalene ..	128	0.0031	†
Acenaphthene.	153	0.00026	‡

*Does not kill but retards growth.
†Does not kill but retards 99 per cent.
‡Does not kill but retards 83 per cent.

Toxic Principles of Creosote Oils

Much has been written about the essential preservative elements of creosote. For years the argument centered about the point of whether or not the tar acids were the chief constituents, and even today the statement is quite often encountered that certain tar acids are the essential constitutents of coal-tar creosote. Thus far, however, our work has shown that in creosote as a whole the aromatic hydrocarbons are at least four times as toxic as their corresponding phenols (tar acids), provided that the hydrocarbon is sufficiently soluble in water to exert its lethal effect. It has also been shown that when two hydrocarbons, neither of which is sufficiently soluble in water to inhibit the organism entirely, are used together, the effect of the mixture is greater than that of either alone; and if two or more components are properly chosen a mixture can be obtained which will totally inhibit fungus growth. Yet there has not been obtained from creosote any mixture of hydrocarbons boiling *above* 270° which is sufficiently soluble to inhibit timber-destroying fungi, while on the other hand all mixtures of creosote hydrocarbon oils distilling *below* 270° possess a very high toxicity. So much for the evidence as to where the actively toxic principle of ordinary creosotes lies.

We know, nevertheless, that the commercial high-boiling oils of coal-tar, such as carbolineums, are toxic to timber-destroying fungi despite the fact that but a very small portion of them distills below 270° C.; we know, too, that high-boiling oils from water-gas tar do not possess toxic properties to anywhere near the same degree, whereas if hydrocarbons boiling below 270° C. were totally responsible for the toxic effect of coal-tar creosote, then similar boiling water-gas tar distillates, if entirely aromatic, should be as toxic as coal-tar distillates. This is true only for those distillates which have a major portion of their oil distilling below 270° C. It is therefore evident that the high-boiling fractions of coal-tar creosote owe their toxic effect to something besides hydrocarbons.

Experimental

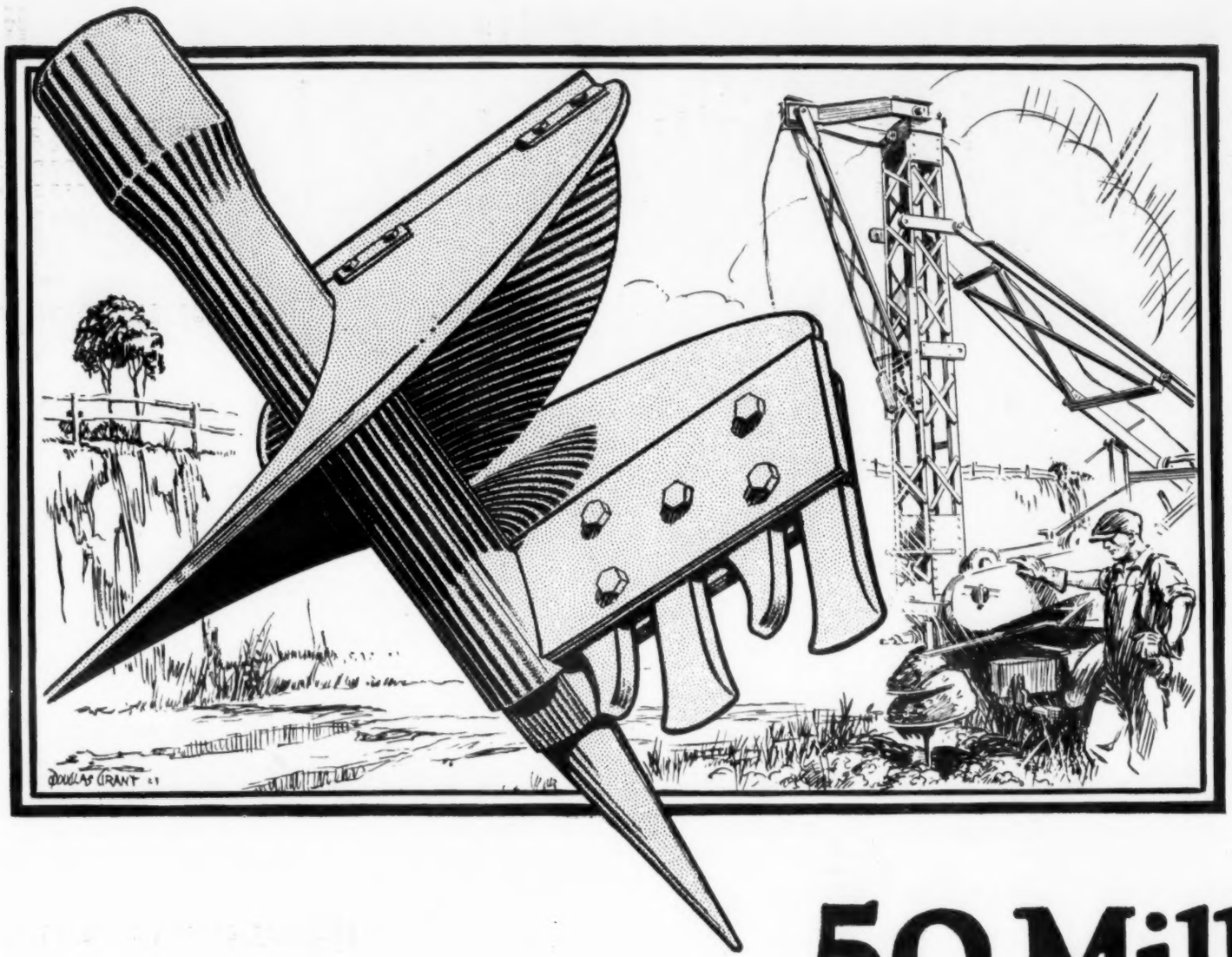
The following experiments were performed with a view to proving or disproving the presence of some toxic material other than hydrocarbons in high-boiling fractions of coal-tar oils. A number of samples were prepared from the same creosote by discarding different proportions of oil distilling below 270° C. These samples were tested for toxicity. Similar samples were then prepared from the same creosote but were first thoroughly washed with caustic soda and dilute acid to remove the tar acids and the tar bases before testing their toxicity. The growth of the test fungus at the different percentages of oils used is recorded in Table 2. In many cases no actual killing point was obtained. The tests were not repeated, however, because it was believed that the information was sufficient even if a definite figure could not be secured for every test. The toxicity of the treated (washed) and untreated oils is shown in Fig. 2. The lower curve, for untreated oils, is of the same kind as those previously published on the relation of toxicity of creosote to the per cent of oil distilling below 270° C. The upper curve is for the treated oils.

A second series of tests was conducted in which a high-boiling oil was carefully treated with caustic and acid in a manner similar to the preceding experiment, but the tar acids and tar bases were recovered separately. The original oil, which had no distillate below 270° C., contained 2.5 per cent tar acids and 3.3 per cent tar bases. Toxicity tests were made on the untreated oil, the treated oil, treated oil to which the original percentage of tar acids had been returned, treated oil to which the original percentage of tar bases had been returned, and treated oil to which both tar acids and tar bases had been returned. In addition, tests were made on samples of treated oil to which beta-naphthol* had been added in the same percentage as the tar acids originally found. The toxicity data collected from this series are as follows:

*The naphthols are probably the chief phenols present in the high-boiling tar acids.

TABLE 2—COMPARISON OF THE TOXICITY OF TREATED AND UNTREATED CREOSOTE OILS.

Untreated oils			Oils treated by removal of tar acids and tar bases		
Amount distilling below 270° C. Per cent	Concentration of oil in toxicity test Per cent	Growth of fungus	Amount distilling below 270° C. Per cent	Concentration of oil in toxicity test Per cent	Growth of fungus
0.0	1.5	1 mm. in 6 weeks			
	3.0	No growth in 6 weeks but fungus still alive			
	15.0	No growth in 6 weeks but fungus still alive			
	18.0	No growth in 6 weeks but fungus still alive			
	20.0	No growth in 6 weeks but fungus still alive			
4.3	1.0	1 mm. in 16 days.	4.9	20.0	1 mm. in 14 days
	2.0	1 mm. in 19 days		30.0	1 mm. in 14 days
	3.0	Growth on transfer in 6 weeks		40.0	1 mm. in 16 days
	4.0	No growth in 6 weeks but fungus not killed			
7.8	0.3	2 mm. in 16 days	8.7	8.0	2 mm. in 20 days
	0.5	2 mm. in 16 days		10.0	2 mm. in 20 days
	1.0	1 mm. in 16 days		16.0	2 mm. in 20 days
				20.0	2 mm. in 20 days
17.1	0.3	1 mm. in 12 days	18.7	1.0	1 mm. in 19 days
	0.4	1 mm. in 24 days		2.0	1 mm. in 20 days
	0.5	1 mm. in 30 days		5.0	1 mm. in 20 days
	0.8	No growth, fungus killed		10.0	1 mm. in 20 days
31.0	0.1	1 mm. in 5 days	27.8	1.0	1 mm. in 20 days
	0.2	1 mm. in 10 days		2.0	Growth on transfer in 6 weeks
	0.3	1 mm. in 14 days		4.0	Growth on transfer in 6 weeks
	0.4	No growth; fungus killed		5.0	No growth; fungus killed
65.0	0.1	1 mm. in 14 days	63.7	0.3	1 mm. in 20 days
	0.2	No growth; fungus killed		0.5	No growth; fungus killed
85.0	0.1	No growth; fungus killed	81.0	0.1	No growth; fungus killed



Post holes dug in short order, in any condition of soil except where blasting is necessary—that's the kind of work an Auto Earth Borer does. Saves time and labor—and money.

50 Million earthworms rolled into one

IT TAKES power to dig a nine-foot hole through hard soil in six minutes. But power is just

earthworms rolled into one

IT TAKES power to dig a nine-foot hole through hard soil in six minutes. But power is just what's back of this husky digger.

The Auto Earth Borer and the Auto Pole Derrick are an unbeatable combination for digging holes and setting telephone poles. These capable tools are typical of many which Western Electric distributes to save the cost of man power and help speed up your service.

Orders that go to extremes

Filling orders that range from a pair of pliers to a 60-foot telephone pole is all in the day's work with us. You can secure complete stocks of everything electrical through Western Electric.

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Western Electric chooses supplies of everything electrical from many markets, and brings them to a warehouse near you—ready for your regular or emergency needs.

To electrical buyers, service like this makes possible a worthwhile economy. Depend on Western Electric, and your own stocks can be largely reduced, with a consequent saving in your investment and expense of storekeeping.

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Have you thought that maple is used in the best cable terminals only because of its fine insulating qualities? Reliable uses the choicest of dry treated maple because of its strength and endurance. Maple withstands the rigors of changing atmospheric conditions without loss of strength or quality. Maple remains chemically unchanged for the life of the cable.

Reliable terminals equipped with self-cleaning discharge blocks without extra charge.

Reliable Electric Company

3145 Carroll Avenue **Chicago, Illinois**

Description of oil.	Growth of test fungus at end of 5 weeks
Untreated oil	No growth on 6% oil*
Treated oil	No growth on 6% oil*
Treated oil + 2.5% normal tar acids	11 mm. growth on 40% oil*
Treated oil + 3.3% normal tar bases	No growth on 5% oil*
Treated oil + 2.5% tar acids + 3.3% tar bases	No growth on 7% oil*
Treated oil + 2.5% beta-naphthol	Slight growth on 10% oil*
	No growth on 1% oil*

*On basis of nutrient agar.

In these results, three points are worthy of consideration: First, that by removing the tar acids and tar bases from the oil the toxicity was reduced enormously; second, that the replacement of either the tar acids or the tar bases or both very nearly approximates the original toxicity; and third, that beta-naphthol is at least as good as the naturally-occurring tar acids, if not considerable better.

Conclusions

The following conclusions are drawn from this study when taken in connection with the previous work on the same subject:

1. The essential toxic materials in coal-tar creosote may be divided into two groups, viz., the hydrocarbon oils boiling below 270° C. and the tar acids and tar bases boiling above 270° C.

2. The hydrocarbon oils distilling below 270° C. are so much more toxic than any other class of materials in coal-tar creosote that they may be considered the essential toxic materials of ordinary creosote oil.

3. The high-boiling tar acids and tar bases may be considered the essential toxic materials for high-boiling distillates, such as carbolineums. In this case the hydrocarbons, although potentially very toxic, are rendered ineffective by their low solubility, leaving the work to the less toxic but more soluble constituents.

Tri-State Report Will Show Good Year

In a letter to stockholders, enclosing check for the usual quarterly dividends of 1½% on preferred stock, President G. W. Robinson of the Tri-State Telephone and Telegraph Co., Saint Paul, Minn., announces that the annual report of the company, now in the hands of the printer, will show continued progress. Gross earnings will show an increase of about 4%, but net income, through economy and efficiency of management, will show an increase of about 9%. Approval of stockholders is asked for an amendment of the company's by-laws so that additional common stock may be issued. This, if approved, will be of advantage in maintaining an ideal ratio between the various securities in future financing operations.

WESTERN CEDAR POLES
Treated or Untreated
G. W. SLACK LUMBER CO.
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Producers of "Glacier Park Cedar Poles"

CEDAR POLES
NORTHERN - WESTERN
BUTT-TREATING - GUARANTEED GRADES
ANY SPECIFICATIONS REQUIRED
BELL LUMBER CO., Minneapolis, Minn.

Mattison, Neb. Chief

Lincoln Man Elected President at Big Meeting of State Association.

Lincoln, Neb.—R. E. Mattison, general manager of the Lincoln T. and T. Company was elected president of the Nebraska Telephone Association at the meeting which marked the passing of the twenty-fifth milestone in the organization's history.

The meeting was featured by a close study of the actual figures concerning the status of the industry in Nebraska, and by a notable address by President F. B. MacKinnon of the National Independent association, who laid to the faults of poor management the fact that earnings of many companies were too small or absent altogether. He cited the Nebraska condition with 200 companies having less than $50,000 annual gross income, earning 4½% on their plant account, and probably less due to inability to figure depreciation properly. The Lincoln company earned nearly 7%. Management made the difference, MacKinnon said. He identified the big problem of the national association as bringing good management to the smaller companies. He advised small companies analyze their situations, and to group themselves with neighboring companies if good management can be installed.

The national chief forecast that in ten years the whole Independent picture would change to a reconstructed, strong and efficient group.

George Presson, field secretary of the association, in telling of the need for rate changes cited the fiscal history of the 212 state telephone companies in 1923. Only 69 paid dividends, 35 showed losses, and 16 did not pay operating expenses.

President Kelly and Secretary Presson spoke of the efforts the association was making to educate the companies so a successful, well-armed battle for increased rates could be conducted. Details were given of the district meetings.

Problems of depreciation and maintenance, were handled from the practical and book-keeping viewpoints by a number of authorities. Hiland H. Wheeler, chief engineer for the Lincoln company distinguished between depreciation and maintenance for the enlightment of those who work under the Nebraska commission rule uniting the two factors.

D. E. McGregor, of the Farmers' Home company of Gibbon, and I. N. Devoe, commission accountant, also spoke on phases of depreciation.

The commission's attitude toward the telephone companies was presented by John E. Curtis, secretary of the regulatory body in an address that was received with great interest and approval. He marked the infrequency of complaints against the state's telephone service, and gave his listeners considerable good advice on bettering public relations.

Relations between the telephone and power lines brought forth practical statements from Mark Caster, Lincoln plant superintendent, who handled the telephone companies' end, and E. Smith, general manager of the Nebraska Power Company who held the fort for the power companies.

Practical addresses were made on telephone taxation by W. H. Barnes, tax commissioner for the Northwestern Bell, and on court decisions relative to the principles of regulation, by Professor J. E. Kirshman of the University of Nebraska. The Nebraska workmen's compensation law was explained by Thomas C. Woods, vice-president of the Lincoln company. Mr. Woods urged the smaller companies to carry compensation insurance and fight for a change in the state law which would allow a lower rate.

Miss Anne Barnes spoke on the responsibilities of managers toward the operating room, and the importance of correct training of operators.

A "question-box" that developed lively interest and extemporaneous remarks on Nebraska conditions, also figured in making the sessions snappy.

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There is better construction in Victor batteries than any other battery. Its construction is checked by our control of all the ingredients that go to make up a Victor Battery. The Zinc, which in the Victor batteries is the heaviest of that on any dry battery, is selected with regard only to its excellence.

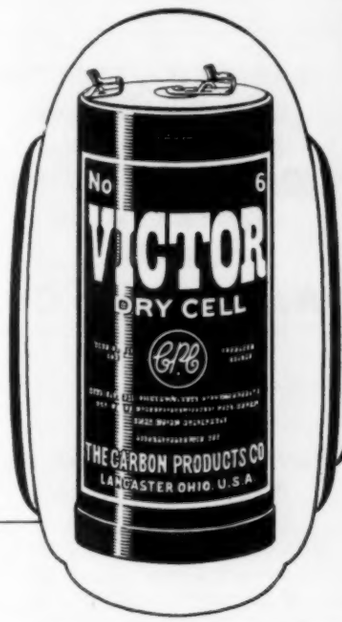
In inspection of Victor batteries, we staunchly maintain that we have the most complete system in existence. Incisive departmental inspections are followed by a "final" inspection to make sure that you get the best battery money can buy.

You're always sure of fresh batteries when you buy Victors.

With all the carefulness and well-founded details of design that Victor batteries reveal, you might think that you'd have to pay more for them.

But you don't!

So better write us for the name of your nearest Victor distributor and learn quickly all the reasons why you should standardize Victors.



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Dean 3 and 4 bar A. C. .....$2.00 and $2.50
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American Electric 3 or 4 bar A. C. .....$2.00 and $2.50
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Victor and Ace Batteries
Dowel Pins

A. J. Johnson Co.
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(Tel. Haymarket 9189)

Northern White Cedar Men Meet at Minneapolis

Minneapolis, Minn.—H. S. Gilkey of Pendleton and Gilkey was elected president of the Northern White Cedar Association at the 29th annual convention of that organization.

The meetings were featured by discussions concerning the new pole specifications and comparison of the selling campaigns of the northern cedar interests with those of the yellow pine men.

Phone Booth Bar New Trick of Bootleggers

Newport, Ky. — "Operator, gimme Old Crow 1907," seems to have been the popular call at the cafe of Mike Steffan here, for police officers discovered a telephone booth into which, it is alleged, liquor was handed thirsty patrons.

Ray Ridpath Goes With Indiana Steel and Wire

Muncie, Ind.—Ray C. Ridpath, widely known in the Independent telephone industry as a supply sales authority, now is with the Indiana Steel and Wire Co., doing sales promotion work in the telephone industry. Ridpath's work is especially concerned with acquainting the telephone industry with the merits of the new Crapo galvanizing process which is exclusively controlled by the Indiana company.

Ray Ridpath, Indiana Steel's new hired man

Ridpath's first connection in the telephone business was with the Indianapolis Telephone Company, for which he became purchasing agent. For four years following his resignation at Indianapolis he was supply sales manager for Kellogg. For the last three years, he has been manager of the Monarch supply sales, leaving that position to go with the Indiana Steel and Wire Company.

Cleveland, O.—From the 7500 public telephones in Cleveland, Raymond H. Cheetham of the Ohio Bell takes an average of more than five pounds of worthless metal daily.

Whatever Your Question

Be it the pronunciation of **vitamin** or **marquisette** or **soviet**, the spelling of a puzzling word—the meaning of **overhead, novocaine**, etc., this "**Supreme Authority**"

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Find Many Uses for Telephone Circuits

Chicago, Ill.—During 1924 six separate and different uses of telephone wires were made.

The wires have been used for local telephone purposes, for long distance telephone conversations, for telegraphing news stories to newspapers, for connecting up the public address system, for connecting sixteen radio stations scattered over the country to broadcast the proceedings at the National Republican and Democratic Conventions, and for sending photographs, finger-prints, cartoons and sketches by telephone.

Paterson, N. J.—The Okonite-Callender Cable Company, Inc., has purchased a plant here, where it will manufacture lead-covered paper insulated cables.

LINE AND DESK

IMPORTANCE OF PREVENTIVE MAINTENANCE.

When the Trouble Demon comes around with his destructive tendencies he finds a determined opponent, who prevents the mischievous imp from doing any real damage.

While the demons more or less influence the trouble situation to help or hinder, the real burden of the work falls upon the repairman; his knowledge, his skill and his ability are the factors which get the trouble cleared. Furthermore, he not only clears the trouble, but is at all times watching the plant in his district for conditions which are liable to cause trouble. For example, if he should see that the limb of a tree had grown out so that it rubbed against the telephone wires leading into the house, he would recommend that the drop be re-run or be protected by tree guards. If this condition were not remedied the insulation would eventually be worn off the wires and a "short" or "ground" would result, which, of course, would cause trouble on the telephone.

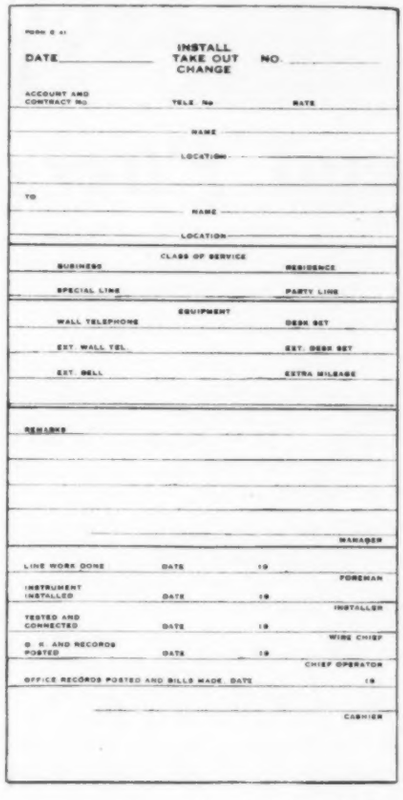
Preventive Maintenance is the name given to this phase of the repairman's work, and it is an important one. The repairman is taught always to be on the alert watching for conditions which might cause trouble, and eventually he develops a sixth sense in this regard. When he clears trouble at a station he makes a rapid but thorough inspection of the equipment. If he sees that the instrument cord is worn he changes it, or if he observes any other condition which would cause trouble he rectifies it, or else recommends that the work be done.—Edmund W. Sheehan in "Bell Telephone News."

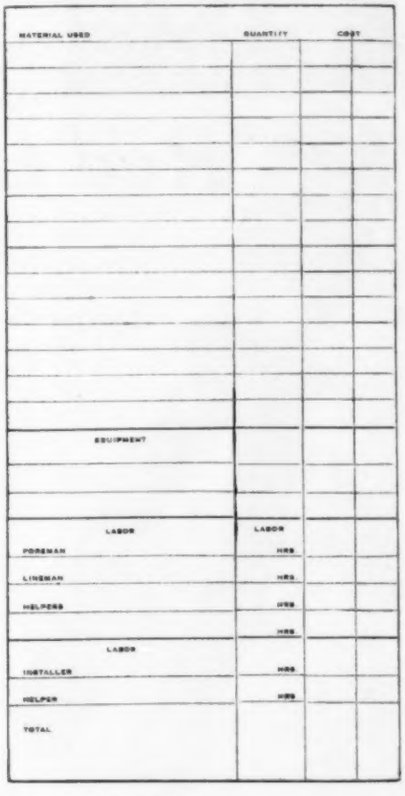
CONVENIENT INSTALLATION ON ORDER SYSTEM

One of our friends, who modestly asks that his name be withheld, has described to us a system of handling installation orders that seems to have many advantages. No elaborate record system is required, and yet all the necessary operations are clearly shown. All contract orders pass over the manager's desk and an order card on the accompanying form is written.

This card then goes to the Plant Superintendent, who routes the card, either to the line foreman or to the installer, depending on whether line work is necessary. If line work is required, the foreman does the work, entering the time when the work was completed on the face of the card and entering the time and material on the back. The card then goes to the installer who makes the installation and enters on the front of the card in the proper space the time when he finished the work. His time and the material used also are entered on the back of card. When the cable records and line records are completed, after the installation is tested, the time is entered in the wire chief's column and the card goes to the chief operator, who corrects her records and sends the card to the accounting department. Here the office records are posted and the initial bill is made, after which the card goes into the files of completed orders.

The same form is used for "install," "take out" and "change" orders by striking out the lines that do not apply. The card is printed on a light cardboard (tag, post card or bogus bristol stock) which stands the wear of passing through several hands. A book record, containing the order numbers, dates issued and enough information to identify the order, is kept on the manager's desk so that the completion of orders may be checked and any delay followed up.—Staff Contribution.





Front of installation order; to right, its back.

AN INDUCTION CASE FOR 2300 VOLT LINE ON POLES WITH TELEPHONE LINE.

A New England subscriber sends us a question relative to induction from an electric light line, parallel to some of his circuits. "I have an electric light line, 2300 volts and transformed to 110 volts. The system is a single-phase, 60-cycle. This runs on one mile of our poles. Its cross arms are four feet above our cross arms but its small cross arms come under ours at right angles for house service. The noise is very pronounced at every instrument. Can you please help me in this trouble?" The sketch accompanying the letter shows a metallic tele-

phone circuit, extending beyond the end of the electric line.

Ordinarily, a balanced 2300-volt line will not cause much noise on telephone lines, if the parallel is only one mile long and the telephone lines are properly transposed. When noise occurs, under the conditions given in the question, both the telephone and electric lines should be tested for balance. The telephone line should be tested to see that there is no ground on either wire and to make sure that there are no high-resistance joints. It should be free from broken insulators, or places where the wire is in contact with poles or cross arms. Likewise, all tree contacts should be trimmed out, or insulated wire used. Our suggestion is that the first step be to clear up the telephone line, as just indicated.

If trouble persists after the telephone line is thus cleared, the next step is to attack the electric line. It should be tested to see that there is no ground on any of the three wires, if it is three-phase; or on any of the two wires, if it is single-phase. This test can be made with a voltmeter and instrument transformer in a way that is known to most electric light men. If there are no grounds, the next step is to check over the electric circuit. It may be possible that the line on your poles is a single-phase branch of a three-phase line. If this is the case, noise is likely to occur which can not be entirely remedied except by insulating that section on your poles through a transformer, or by making the entire system three-phase. If the system is three-phase with single-phase branches, the noise may some times be reduced by rearranging the single-phase branches so that the lengths of the wires on the three-phase line are approximately equal.

In case the trouble is not found to be due to unbalanced conditions in either the telephone or electric line, it may be necessary to install a co-ordinated transposition system. Before installing such a system, we would recommend that all of the above suggestions be tried. In case none of them proves effective, if our subscriber will write again, giving results, we will give a transposition layout that should reduce the noise.—Staff Contribution.

ELIMINATING INTERFERENCE CAUSED BY POLE CHANGER TO RADIO RECEPTION.

Complaints are becoming so numerous from radio listeners, on account of the interference caused by pole changers at telephone exchanges, that I think the following information may be of interest to telephone companies that may be troubled with such complaints.

I have to operate a radio-telegraph station in the telephone exchange at Buchanan, Sask., Can., within twenty feet of a pole changer, and it became quite impossible to copy signals while that instrument was in operation.

After some consideration of the matter, I inserted a commercial, long-wave, honeycomb coil in each of the leads from the pole changer to the switchboard, the coils being connected at the pole changer terminals. This fixed matters up and I gave little further attention to the question.

As broadcast listeners became more numerous and complaints from other towns were being forwarded to the Department of Telephones at Regina, I submitted my choke-coil scheme to them for investigation, and it was found, taking everything into consideration, that the 200-turn coil worked to greatest advantage.

No doubt, however, special-wound choke coils will be manufactured by the electrical companies for this purpose in the near future.—Contributed by P. H. Jones, Buchanan, Sask.

OLD POLES ARE DANGEROUS.

"We recently have had several accidents that occurred because employes failed to test old poles properly before ascending," said a member of the Accident Prevention and Health Betterment Committee, recently. "This class of accidents easily can be reduced by following the simple instructions issued by the company, and the Safety Bureau again calls this to the attention of all having work to do wherein pole climbing is involved. One important thing which should be watched for is the 'honeycombed' or ant-eaten pole. A thin layer on one side of the outer circumference of the pole shows but very little decay, but the rest of the area often is badly eaten or 'honeycombed' by ants or other insects. The pole looks to be solid, but oft-times the least pressure or pull will completely break it off.

"So look out for all old poles; they might not be as safe as they look. Inspect them all before ascending, especially so, if you are dismantling. Punching with a bar is not always a sufficient test; neither is the pushing of pole with a pike to see if it is solid, although these tests, if no others are at hand, are far better than no test at all. The safe way, if all guys and wires are to be removed, is to pike or guy the pole in all directions. Temporary guying or bracing takes a little time, but brings rich rewards. Think this over before you climb any pole that you are not absolutely sure of."—"Bell Telephone News."

EQUIPMENT FOR SALE

FOR SALE: Magneto exchange, grounded system. 110 subscribers, no competition. Priced to sell. Address W. L. Punches, Walton, Kan.

TRADE MARK Red Devil Tools — "Red Devil" THE WORLD'S STANDARD — Better Made

"Red Devil" No. 4950. Made in 6, 7 and 8 inch sizes

"Red Devil" Pliers

This "Red Devil" extra heavy, insulated side cutting Plier sets an example of safety that is typical of all other "Red Devil" Linemen's and Electricians' Tools.

Made for high tension work. Insulation is tested to stand 10,000 volts. Insulation is one-eighth inch thick and is guaranteed not to deteriorate or crack when dropped. Plier is made of finest quality steel, specially tempered.

This tool meets the most exacting requirements demanded by electrical companies for a perfect insulation and a perfect plier.

Send for the Electrician's tool booklet.

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Manufacturers of "Red Devil" Tools
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Plan Busy Season

Reports from Representative Companies Indicate Good Weather Will Bring Lively Buying and Building

Ariz., Kingman—Arizona, California and Nevada Telephone Co., H. C. Newell, cashier, reports "a great deal" of work to be done this season but list has not yet been completed and supplies have not been ordered.

Ark., Monette—Inter-River Telephone Co., C. C. Watson, Mgr., plans general rebuilding of two of its plants this season and will build 20 miles of extensions. About 10,000 feet of cable, poles and all miscellaneous construction supplies will be wanted for July 1 delivery.

Cal., Los Gatos—Los Gatos Telephone Co., F. F. Watkins, Mgr., reports the following work contemplated: 1,000 ft. of 400-pr. underground cable; 1,650 ft. of 300-pr. cable; 500 ft. of 200-pr. cable, and 3,000 ft. of 100-pr. aerial cable.

Ill., Chesterfield — Chesterfield Telephone Co., W. J. Finch, Pres., will do some rebuilding this summer and will want delivered, in March and April, cable, wire, poles and other construction supplies.

Ill., Clifton—Illinois Local Telephone Co., E. C. Fish, Pres., reports twenty miles of reconstruction work on its schedule. Poles, cross arms, hardware, insulators and eight tons of No. 12 wire are wanted for April delivery.

Ill., Geneseo—Geneseo Telephone Co., Phineas Morrow, Sec., reports that they may rebuild next year. Nothing special is contemplated just now.

Ill., Hillsboro—Peoples Mutual Telephone Co., Walter R. McLean, G. M., expects to rebuild three exchanges this summer and construct 30 miles of new metallic toll circuits. Considerable extension work also is planned.

Ill., Morrison—Morrison Telephone Co., F. Trautwein, G. M., will install some 4,000 feet of cable, commencing May 1.

Ill., Pittsfield—Pike County Telephone Co., Ed. Glandon, G. M., reports that the recent sleet storm necessitated practical rebuilding, so that but little new work is contemplated for the remainder of the year.

Ill., Rochelle—Rock River Telephone Co., R. L. Heydacker, G. M., will rebuild Mt. Morris exchange this season, making it metallic cable construction. Among the supplies required about April 1 will be cable, strand, rings, poles and hardware.

Ind., Aurora—Southern Indiana Telephone Co., R. V. Achatz, Sec., will install about 10,000 ft. of cable in its Lawrenceburg exchange and will do considerable other general work around the Aurora plant and on the toll lines. The cable has been bought but terminals and miscellaneous supplies are yet to be ordered for July 1 delivery.

Ind., Greencastle—Greencastle Telephone Co., Lawrence H. Finney, G. M., will replace a large part of its open wire plant with cable this summer.

Ind., Huntingburg—Dubois County Telephone Co., Carl W. Koerner, G. M., expects to move into its new fireproof building about May 1, and will install a modern, common-battery switchboard and 600 common battery telephones, which Mr. Koerner says under date of Feb. 24th "may be purchased within next 10 days." The company's new building is 25x150 and costs $35,000.

Ind., Indianapolis—J. K. Johnston, Lemcke Bldg., Indianapolis, has purchased The Advance Telephone Co. Its exchange will be moved and new central office equipment installed. Considerable new cable will be added and extensive improvements made. This company recently received increase of rates before the Public Service Commission.

Ind., Lyons—Lyons Co-operative Telephone Co., reports but a small amount of work planned for this season. Supplies not yet ordered.

Ind., Osgood—Osgood Telephone Co., H. L. Jenkins, Sec.-Mgr., reports 3,000 feet of cable construction already underway.

Ind., Pendelton—Pendleton Telephone Co., R. E. Brookbank, Mgr., will finish its cable estimate and rebuild about two miles of country lines this year. Wire and strand will be needed.

Ind., Portland—Home Telephone Co., Frank White, Pres., reports only general up-keep of plant planned for this season.

Ind., Rochester—Rochester Telephone Co., Henry A. Barnhart, Pres., has contracted for rebuilding of its switchboard and is changing 250 rural magneto telephones to common battery. The company also is putting lightning arresters on all rural telephones this year and will lay about two miles of its aerial cable underground. Construction in general also will be overhauled and renewed.

Ind., Whitestown—Whitestown Citizens Telephone Co., Clyde O. Laughner, Sec-Treas., will rebuild country lines and will want cross arms, insulators and pins about April 1.

Ia., Brighton—Brighton Mutual Telephone Co., K. M. Elmore, Mgr., reports that a bad storm last June practically put their plant out of commission but that it now is in good condition again.

Ia., Clearfield—Clearfield Mutual Telephone Co., S. H. Fosmire, Sec., will install abcut 1300 feet of 25-pair cable and some two miles of open wire construction this season, commencing April 15.

Ia., Corning—Corning Telephone Co., John A. Anderson, Pres., will install a new 500-line, central energy switchboard this year.

Ia., Fayette—Fayette County Mutual Telephone Co., J. H. Morf, Sec., will do minor repairs and extensions only this season. A carload of poles already has been ordered.

Ia., Gowrie—Gowrie Telephone Co., J. E. T. Johnson, Mgr., will do some cable work and rebuilding this summer.

Here Is the Point!

That saves endless trouble and time for the repairman. The WARD SWIVEL POINT Electric Soldering Iron solves every difficulty in reaching the most inaccessible places—no taking apart entire switchboards to reach the trouble.

The WARD SWIVEL POINT Iron is so constructed that short-circuiting is impossible. Indispensable for telephone work where it can easily reach awkward connections in Switchboards, Terminals on Relay, Arrester and Distributing Frames.

Approved and listed as Standard by Underwriters' laboratories. Built of the finest materials. Maintains even temperature. Handle never heats up. Insulated so that Iron will not "ground." Price $3.25. For sale by your nearest source of supply. All good distributors handle the WARD Iron.

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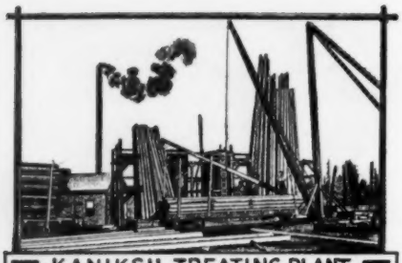

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All Styles of BUTT TREATING
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Approved by Large Operating Companies For the Following Strains

6" 2-way	2,200 lbs.
6" 4-way	6,000 lbs.
8" 2-way	6,000 lbs.
8" 4-way	10,000 lbs.
10" 4-way	16,000 lbs.

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Highest prices paid for discarded or obsolete telephone and switchboard apparatus; platinum contact relays, ring keys, etc. Have specialized in this field for many years.
CONTACT METALS CO.
221 E. 23rd St., Chicago

Send for free sample and prices on
UNIVERSAL DROP WIRE INSULATORS
Universal Specialty Company
120-A, S. 7th St., Terre Haute, Ind.

Ia., Hartley—Hartley Telephone Exchange, H. G. Williamson, owner, will overhaul the farm lines this summer and will need brackets, cross arms and No. 12 wire.

Ia., Greenfield—Lincoln Mutual Telephone Co., R. M. Wilson, Sec., will put in several blocks of cable and otherwise put its lines in shape for good service.

Ia., St. Ansgar—St. Ansgar Telephone Exchange Co., S. J. Peshak, sec., is rebuilding six miles of rural lines this year.

Ia., Greene—Shell Rock Valley Telephone Co., D. C. Phillips, Pres., reports plant sold to C. E. Rex, who took possession March 1.

Ia., Keosauqua—Van Buren County Mutual Telephone Co., D. R. Hornbaker, Sec. (Bonaparte, Ia.), will continue its line construction program this year. A carload of poles will be wanted by mid-summer. This company recently bought out the Farmers Connective Telephone Co. of Bonaparte.

Ia., Villisca—Villisca Farmers' Mutual Telo. Co., John Mullen, Sec., reports regular run of repair work for 1925.

Kans., Cawker City—Cawker City Mutual Telo. Co., H. E. Miller, mgr., will engage in rebuilding and extending its lines this season, and will want wire, poles and cross arms this month.

Kans., Holton—American Telephone Co., C. B. Ford, mgr., will have its report to make later. At present plans for the current year have not been decided upon.

Kans., Osborne—Osborne Telephone Co., H. W. Loomis, Mgr., will lay a lot of underground cable this year. Necessary cable and other supplies are wanted.

Kans., Valley Falls—Delaware Valley Telephone Co., B. R. Hinchman, Gen. Mgr., will rebuild rural lines and install new cable. Most of the necessary supplies have been bought, but some good second hand magneto telephones can be used.

Kans., Wamego—Wamego Telephone Co., Harold Child, Mgr., will rebuild some of its country lines this year. A carload of poles is desired.

Ky., Hopkinsville—Christian Todd Telephone Co., C. E. Woodruff, G. M., will do only minor work this season.

Mich., St. Johns—Clinton Telephone Co., Leslie G. Brown, Mgr., will rebuild some of its older lines this summer.

Mich., Grand Ledge—Grand Ledge Telephone Co., G. M. Enery, Sec.-G. M., expects to replace 10,000 feet of 400-pair underground cable this season in addition to the usual amount of repair work.

Mich., North Branch—North Branch Telephone Co., J. H. Vandecar, owner, reports that the regular run of work only will be undertaken this season.

Minn., Fulda—Fulda Telephone Co., Max M. Siman, Mgr., reports but little construction work planned for this year other than the ordinary repair work.

Minn, Springfield—Farmers & Citizens Mutual Telo. Co., J. S. Shrader, Pres., reports that they are laying 10 blocks of underground cable and rebuilding about six miles of rural lines.

Minn., Twin Valley—Twin Valley-Ulen Telephone Co., H. E. Grutle, mgr., will undertake replacements this season and will need No. 12 galv. wire, cross arms, bolts and other construction supplies in May.

Minn., West Concord—United Telephone Co., E. C. Kaiser, Sec.-Mgr., plans considerable trouble-prevention work for this season and a small amount of new construction. Two blocks of underground cable are to be installed. Supplies wanted include cable and construction supplies.

Mo., Columbia—Columbia Telephone Co., E. F. Carter, Mgr., will extend and add to its aerial cable this year, providing about 3,000,000 more conductor-feet.

Mo., Shelbyville — Shelbyville Telephone Co., L. A. Kaylor, Mgr., plans but little work this year as they installed 3000 feet of 200-, 150- and 75-pair underground cable last season.

Mo., Willow Springs—Willow Springs Local & Long Distance Telephone Co., W. N. Wicks, Mgr., will move its office this summer. Necessary supplies will be needed about July.

Neb., Tilden—Madison Telephone Co., Neal A. Wyckoff, mgr., is rebuilding this season.

N. Y., Johnstown—Glen Telephone Co. contemplates for 1925 considerable new building, aerial and underground construction and a small central office installation.

N. Y., Solsville—Madison Mutual Telephone Co., Willard T. Taylor, Sec.-Treas., is rebuilding nearly all of its lines this year and will require cross arms, brackets, pins, wire, insulators, etc., in April and May.

N. Y., Tannersville—Schoharie Telephone Co., Flavius Dibbell, Mgr., plans about a mile of cable and about ten miles of aerial wire. Will want cable, messenger and accessories.

N. C., High Point—North State Telephone Co., J. F. Hayden, mgr., has some underground construction on its program for this season. Ducts, cable, etc., will be wanted on or before July 15.

O., Newark—Newark Telephone Co., W. L. Cary, Mgr., will complete this season the rebuilding work which it has underway.

O., Sugarcreek—Berlin Telephone Co., J. M. Hochstetler, Pres. Mgr., will install underground cable this summer, and will want 200-pr. lead cable and construction tools in May.

(*Continued on page* 44.)

—Courtesy Burgess Battery Co.

Among the celebrities who attended the Wisconsin telephone convention (left to right): Secy. J. A. Pratt, Madison; Director Walter J. Gallon, Antigo; J. M. Storkerson, La Crosse; Sen. Howard Teasdale, Sparta; F. B. MacKinnon, president, U. S. Independent Telephone Association; P. J. Weirich, Monroe; W. F. Goodrich, La Crosse; F. H. Runkle, Portage; Sen. W. L. Smith, Neilsville, president W. S. T. A.; H. A. Price, Markesan, former president W. S. T. A.

Badgers in Big Confab

Sixteenth Annual Wisconsin Meeting Deals With Live Problems.

Madison, Wis.—Wisconsin State Telephone Association waded into battle with the problems of the industry in that commonwealth, in regular crusader fashion, by opening each session with song.

In the presidential address, State Senator W. L. Smith, whom the association again named its chief, dealt with the outside opinion of Wisconsin as a socialistic state, due to the spotlight outbursts of some of its politicians. The insurance problems to which the group has been devoting considerable attention for some time were getting nearer a satisfactory solution, so President Smith stated. As a result of one of the executive's recommendations, the convention appointed a "committee on committees" with power to name committees necessary for work that in the past has been passed onto the overloaded shoulders of the state's most active telephone men. He also advised the election of a Wisconsin Bell man to the association's directorate. F. M. McEniry, of Milwaukee, was elected to this position. S. L. Odegard, of Madison, was elected to the other vacancy on the directorate. F. H. Runkel and H. A. Price retired from the directorate. There were no other changes in the executive roster.

A lively discussion on "How Far is Standardization of Telephone Equipment Desirable," was begun by the remarks of H. A. Price, who told of his experiences in eventually standardizing a three-bar, 1000-ohm bridging instrument for local use, and a 5-bar, 1600-ohm instrument for rural use. He said he could keep closer to his standard by changing makes occasionally. He also stressed standardization in materials and construction. Others who spoke on standardization were F. H. Runkel and A. W. James.

H. R. Huntley, transmission engineer of the Wisconsin Bell spoke on transmission and illustrated his remarks with slides relative to losses in local and long distance transmission. He demonstrated the effects on the transmitted voice of low-pass and high-pass filters in the circuit.

Close contact between the state authorities and the telephone industry was evident in a number of the addresses. F. M. Wilcox, chairman of the Industrial commission spoke on the effect of recent court decisions on the minimum wage and hours of labor laws for women employes, Professor Aust, of the University of Wisconsin's department of Landscape Design, talked on tree trimming and C. B. Hayden, of the Railroad commission told of the administration of service standards for telephone utilities.

Frank J. Mayer, district plant superintendent of the Wisconsin Telephone Company, spoke on safety first, telling of the effect of education in this direction making the telephone industry one notably free from serious accidents.

Financing the state association was the topic dwelt upon by President F. B. MacKinnon, of the National Independent association. More business management and constructive planning he emphasized were the principal needs of the telephone industry.

Miss Anne Barnes handled the subject of traffic problems with particular reference to the work done by the Iowa association.

The report of Secretary John A. Pratt brought forth details of the big job that the association's handy-man handles in functioning at district conferences, and in caring for the S. O. S. calls sent out by member companies.

Saying that too many of the Wisconsin companies are undercapitalized, Mr. Pratt stated that "the total invested in plant for 205 Class D companies represents considerably less than $50 per station, while 77 Class C companies report a total investment, including toll lines and other facilities, of less than $60 per station.

"The disproportion in the ratio between revenues and investment creates a wrong impression and, of course, such companies must sooner or later come to grief. For example, one company reports $6,000 revenues on an investment of $5,400, while a number of companies have a ratio of revenues to investment running from 50 per cent to 70 per cent.

More attention was directed to the financing of telephone companies by the remarks of F. M. McEniry on "Use of Financial Data in Telephone Exchange Management." H. O. Leinard, assistant to the vice-president, A. T. and T. Company, spoke on the friendly relations prevailing between all factors in the telephone industry.

"Providing Telephone Service for a Reasonable Return to the Investor," was the subject of an interesting summary presented by J. E. Carroll. Proper testing methods was the secret of successful switchboard maintenance in small exchanges, according to C. R. Brown, of Madison, who made an intensely practical talk on switchboard maintenance.

Some of the bright young men who represented manufacturers at the Badger meeting

Bell's Annual Report

A. T. & T. Now Is in Many Ways the Largest Corporation in the World.

The annual report of H. B. Thayer, chairman of the board of the American Telephone & Telegraph Co., asks for authorization to increase the company's capitalization $500,000,000 to provide for future growth. None of this is to be issued this year, however.

The A. T. & T. now has over $900,000,000 in stock outstanding, thus exceeding the U. S. Steel Corp., which has $868,500,000 outstanding, while General Motors Corp. is capitalized at $1,110,000,000.

The A. T. & T.'s net earnings available for interest and dividends in 1924 were $107,619,362, a gain of $12,239,444 over 1923. Interest charges took $16,573,041, 20 per cent more than in 1923, and left net available for dividends $91,146,321, or $11.31 a share on the average amount of stock outstanding, compared with $11.35 in 1923. These figures do not include equity in undivided profits of subsidiaries. Dividend charges were $70,918,227, an increase of $7,643,839, reflecting the greater capital stock now outstanding.

Of the resulting balance of $20,128,094, the company appropriated $3,000,000 for contingencies and $17,128,094 to surplus. The total surplus Dec. 31, 1924, was $127,253,578.

The report shows 345,466 stockholders, largest of any corporation in the world, one-sixth being Bell system employes who own an average of nine shares each. There is now one Bell owned or Bell connected telephone for every seven persons in the United States, a total of 15,906,550. Calls last year were 7.1 per cent more than in 1923, the daily average being 45,000,000 calls.

REPAIRMAN WANTED

WANTED—Troubleman, general telephone repairman, at present employed, wishes change. Seven years' experience Magneto and Common Battery exchanges. 32 years of age. Married. Sober, steady and reliable. Can give first class references. Write P. O. Box 61, Statesville, N. C.

PLANT FOR SALE

FOR SALE—Will release 4500 lines 3-wire Strowger Automatic equipment, including telephones, about May 1, 1925. Details on request. Address Plant Superintendent, Lincoln Telephone & Telegraph Co., Lincoln, Neb.

Additional Construction

N. Y., New York City—The 1925 construction program of the Bell System—that is, the American Telephone and Telegraph Co. and Associated Companies—will call for about $255,000,000, to be expended in net additions to plant to meet the increased demand for service.

Ind., Terre Haute—Citizens Independent Telephone Co., A. L. Staderman, Sec.-Engr., reports that they plan an extension to their building at Terre Haute and will install some 1200-pr. and smaller-size cables to relieve congestion due to the system's growth.

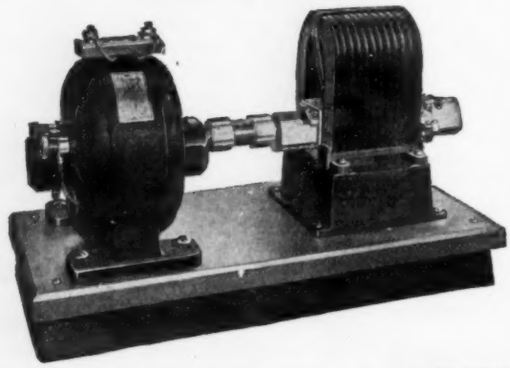
Mo., St. Louis—Southwestern Bell plans to spend $21,500,000 on improvements and additions to its plant in five states this year.

Ore., Silverton—O. L. Brown, Mgr., reports following work contemplated: 3000 ft. of 25- and 50-pr. cable; four miles of 30-ft. pole line and five miles of 25-ft. pole line. Supplies required include cable, poles, messenger, rings, hangers, etc.

Wash., Waterville—Farmers Independent Telephone Co. considers only ordinary repair work for 1925.

Dependable Ringing Service —with Economy!

A Holtzer-Cabot Magneto Ringing Motor-Generator



is the ringing equipment that NEVER FAILS. It is uniformly dependable—and economical in first cost and in upkeep. It needs no costly attention — if properly lubricated.

Send for illustrated circular. Or, better still, give it a test in your exchange, we stand back of the machine.

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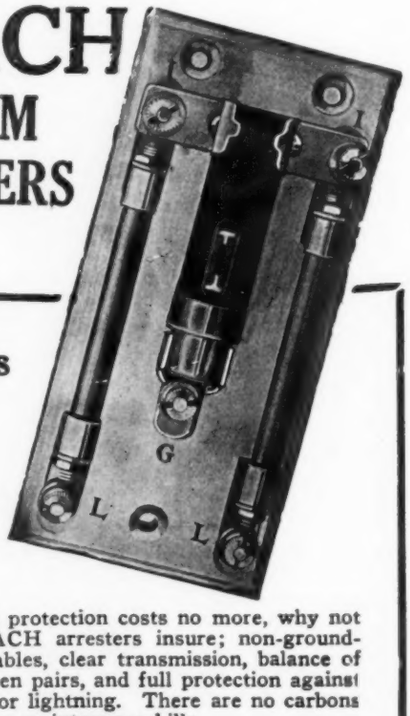

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Know EVER-PROTECT CABLE COMPOUND before you start spring work

You will save thousands of dollars eventually from the construction work you do this spring if you bury cable underground without conduit, using Ever-Protect Cable Compound.

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Order from your Jobber or Direct

Not only underground, but overhead, is a coating of Ever-Protect valuable to you. It saves your cable in places where smoke usually makes short work of sheath, and where squirrels gnaw through the sheath, a coating of Ever-Protect immediately puts an end to that practice.

Ask us or your nearest live jobber for full details of Ever-Protect Cable Compound so you may soon decide where you can use it in making this spring's construction work the best you ever have done.

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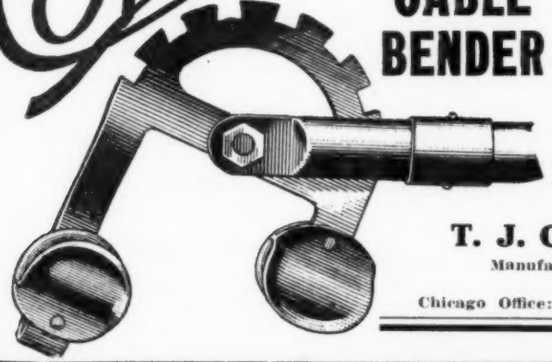
CABLE BENDER



The increasing demands for larger sized cables in underground electrical transmission has created a demand for a cable bending tool so constructed that it could be adjusted to meet every condition or requirement that might arise in the placing of cables in manholes or vaults without disturbing other cables.

The Cope Type "C" Bender will meet these requirements.

The Cope Type "C" Bender is designed especially for bending soft core cables without injuring the lead, and to eliminate the necessity of redressing after bending.

The Cope Type "C" Bender is made of steel throughout, tested to withstand any reasonable strain that it would be subjected to. Its adjustments will permit the handle to be placed in seven (7) different positions.

No tool cart is fully equipped without one of these Benders.

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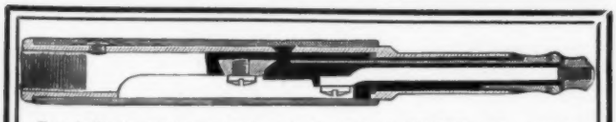

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Construction Plans

(*Continued from page* 40.)

O., Waynesfield—United Farmers Telephone Co., Fred W. Bechdolt, Pres., will buy a new magnet and switchboard for the office at West Newton. A lot of rebuilding also is to be done this year. Hardware, poles, wire, cross arms and 25-pr cable are among the supplies needed.

Okla., Pond Creek—Grant County Rural Tel. Co., R. E. Sullivan, Mgr., is planning a lot of repairing and overhauling this year.

Pa., California—Union Telephone Co., P. M. Asmus, Mgr., reports its plant for sale. The Bell may take it over.

Pa., Johnstown—Johnstown Telephone Co., J. T. Carliss, Supt., plans extensions to its aerial and underground cable plant this summer. Supplies all purchased.

Pa., Le Raysville—Peoples Consolidated Telephone Co., H. G. Newell, engineer, plans general overhauling and repairs for lines and instruments. In the market for locust pines, drop wire, a ringing machine for 110 v. A. C., and the "latest, all-around trouble set."

Pa., Manheim—Mastersonville Telephone Co., A. S. Brubaker, Sec.-Treas., is rebuilding its lines this year, and will need wire, poles and hardware about April 15.

S. C., Lexington—Citizens Telephone Co., S. A. George, Mgr., will rebuild an open lead which carries 28 wires, due to road construction. Wire, brackets, pins, arms and hardware are wanted at once.

S. D., Aberdeen—Dakota Central Telephone Co., W. G. Bickelhaupt, pres., reports that it is planning to do the usual amount of rebuilding and construction of additional facilities during 1925. Provisional estimate carries additions to plants and betterments amounting to $384,829, divided as follows: Additions and betterments to exchanges, including rural lines, $193,529; additions and betterments to toll lines, $191,300.

S. D., Highmore—Hyde County Telephone Co., A. N. Van Camp, mgr., will rebuild some 20 miles of rural lines this year and install underground cable mains in town. Poles, wire, cable, etc., will be wanted for delivery by mid-summer.

S. D., Wagner—Farm & Home Telephone Co., J. J. Bollinger, mgr. (Bridgewater, S. D.), will install a complete underground cable system, including a new central office building, new switchboard, etc. Most of the supplies have been ordered.

Tenn., McKenzie—McKenzie Home Telephone Co., W. R. Gilbert, Mgr., contemplates considerable cable work this season. Cable, messenger, cans, etc., will be wanted about June.

Tex., Haskell—Haskell Telephone Co., John W. Pace, G. M., will begin rebuilding and enlarging the plant at Olney, at once; also, outside construction for C. B. equipment at Seymour. New circuits also are being installed between Olney and Wichita Falls, a distance of 88 miles. Supplies wanted immediately.

Tex., McAllen—Rio Grande Valley Telo. Co., J. A. Frisby, G. M., will build a pole lead from San Benito to Los Fresnos, a distance of 12 miles. Considerable work also is to be done on the company's other plants this year.

Vt., Northfield—Northfield Telephone Co., C. M. Goodrich, mgr., will install about a mile of aerial 100-pr. cable and another mile of 50-pr. cable this summer. All supplies for this job are desired soon.

Vt., Pawlet—Rutland County Telo. & Teleg. Co., W. R. Foote, mgr., contemplates only the necessary repair work for 1925. No great outlay will be involved.

Wis., Almond—Almond Telephone Co., A. H. Bowden, Sec.-Mgr., will devote itself to rural construction work this season, and will need poles, wire and other construction supplies about May 1.

Wis., Baraboo—Baraboo Farmers' Mutual Telo. Co. will change, this season, some seven miles of grounded lines to metallic lines.

Wis., Coon Valley—Coon Valley Farmers Telephone Co., Albert Spellum, Mgr., will install a new Kellogg switchboard at its Coon Valley exchange as soon as mild weather sets in.

Wis., Lancaster—Farmers Telo. Co. of Beetown will do considerable rebuilding this season. Supplies already ordered.

Wis., Milton Junction—Milton & Milton Junction Telo. Co., A. S. Maxson, Mgr., is practically reconstructing its plant, using 25 tons of line wire, a carload of cable at $7,500, Kellogg service switchboard and $10,000 worth of Kellogg harmonic telephones. The old, biased-ringer magneto system is being converted into a modern storage-battery system.

Wis., Mt. Hope—Peoples Telephone Co., Edw. B. Morse, Pres., reports that repairs and overhauling are all that is contemplated at present.

Wis., Rhinelander—Rhinelander Telephone Co. contemplates only the usual repair work for 1925.

Wis., Wausau—Wausau Telephone Co., Howard I. Crawford, Supt., expects to extend its underground system, using about 25,000 duct feet of conduit. Mr. Crawford will be glad to receive quotations from the manufacturers.

RECONSTRUCTED EQUIPMENT

New Western Elec. Co. Mouthpieces, @ 7c—Lots of 50 @ 6½c—Lots 100 @ 6¼c
New Western Elec. Co. No. 142 W Receiver shells with caps @ 37c—Lots of 50 @ 36½c ea.—Lots of 100 @.. 35c
Garford No. 1620 Phantom Coils @... $1.25
Kellogg No. 26A Receivers with cords @ 1.25
Kellogg Local or C. B. Transmitters @ $1.15—Lots of 50 @..... 1.10
American Elec. 5-bar Pony type Bdg. Gen., complete with crank @..... 1.25
Western Elec. Co. No. 22 type 3-bar Bdg. generator complete with crank, @ 1.50
American Elec. 1600 ohm Non self contained ringers @..... 1.00
Garford Straight line C. B. desk sets with steel signal set @..... 6.50
Garford 3-bar 1000 ohm Bdg. desk sets @ $8.75—4-bar 1000 or 1600 ohm $9.25—5-bar @ 10.25
Monarch 3-bar 1000 ohm Bdg. desk set @ $8.50—4-bar 1000 or 1600 ohm @ 8.75
Monarch 4-bar 1000 or 1600 ohm Bdg. compacts @ $7.50—5-bar @..... 9.00
Rebuilt Special 5-bar 1000 or 1600 ohm Bdg. compacts @..... 7.25
Swedish Am. 5-bar 1600 ohm Bdg. compacts @ 7.25
Kellogg No. 30 Common battery wall sets equipped with straight line ringers @ $4.00—Lots of 50 @..... 3.75
Western Elec. Co. 3-bar 1000 or 2500 ohm Bdg. hotel sets equipped with Kellogg, Dean, Monarch or Stromberg Transmitters & Rec. @..... 6.50
Double Pole, single throw knife switches @ ..... .15

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Boston, Mass.—A new catalog of Mead-Morrison motor truck winches, cranes and derricks has been issued by the Mead-Morrison Mfg. Co. of East Boston. Much of the equipment is of considerable value to the telephone industry. A copy of the catalog will be sent free on request.